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ABSTRACT

This guide to teaching graphic arts, one in a series of instructional materials for junior high industrial arts education, is designed to assist teachers as they plan and implement new courses of study and as they make revisions and improvements in existing courses in order to integrate classroom learning with real-life experiences. This graphic arts course is organized into eight units, each containing objectives, vocabulary, teaching aids (such as transparency masters), suggested student activities, and a multiple-choice test with answer key. The units cover the following topics: introduction to graphic arts, printing processes, layout and design, relief printing, gravure printing, screen process printing, planographic printing, and finishing and binding. Appendixes to the guide suggest computer applications in graphic arts and list books, trade journals, and audiovisuals in the field. (KC)

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Graphic Arts

By

Alan L. Towler

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Contents

Foreword / *iv*
Acknowledgments / *iv*
Notes to the Teacher / *v*
Competencies / *vii*

Unit 1: Introduction to Graphic Arts / *1*

I. Defining graphic arts
II. Scope of graphic arts
III. Contributions of graphic arts
IV. Graphic arts industry
V. Historical overview of graphic arts

Unit 2: Printing Processes / *15*

I. Types of printing processes
II. Graphic arts laboratory safety

Unit 3: Layout and Design / *29*

I. Understanding layout and design
II. Proportion
III. Balance
IV. Contrast
V. Rhythm
VI. Unity
VII. Printer's layout

Unit 4: Relief Printing / *43*

I. Relief printing process
II. California Job Case
III. Linoleum block printing
IV. Rubber stamps

Unit 5: Gravure Printing / *71*

I. Gravure printing process
II. Dry-point etching

Unit 6: Screen Process Printing / *83*

I. Equipment
II. Screen material
III. Paper stencil
IV. Design
V. Cutting the stencil film
VI. Adhering the film to the screen
VII. Printing the stencil

Unit 7: Planographic Printing / *97*

I. Offset lithography
II. Basic principles
III. Stone Age of lithography
IV. Presses
V. Photography
VI. The complete cycle

Unit 8: Finishing and Binding / *111*

I. Introduction
II. Bookbinding materials

Appendices:

Appendix A / Computer Applications in Graphic Arts / *125*
Appendix B / Books, Trade Journals, and Audiovisuals / *127*

Foreword

This publication is one of the new series of instructional materials for industrial arts education. It has been designed to assist teachers as they plan and implement new courses of study and as they make revisions and improvements in existing courses. This publication is an attempt to help industrial arts teachers create learning environments that respond to the needs of students growing up in a complex industrial-technical society. It provides a framework that enables teachers to integrate classroom learning with real life experiences of students.

Industrial arts is being challenged to expand and clarify its function. To meet this challenge, the industrial arts curriculum must provide opportunities for students to learn more about the technological realities in our society. This publication provides teachers with an instructional platform that focuses on industrial arts' commitment to establish its content base in the technologies.

Jack E. Robertson, Ph.D.
Director, Extension Instruction
and Materials Center

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Alan L. Towler
Industrial Arts Curriculum Specialist

Notes to the Teacher

Using the Curriculum Material

Intended Audience. The material in this curriculum package is designed for use by junior high/middle school industrial arts teachers in exploratory/introductory programs.

Length of Time for the Material. Each of the four topics of study (introduction to drafting, introduction to graphic arts, introduction to photography, and introduction to computer applications) has been developed to provide enough material for eighteen weeks of study. Individuals who teach six-, nine-, or twelve-week classes can use selected parts of this curriculum material as the substance of their classes.

Emphasis of the Material. Keep in mind that these curriculum materials are exploratory in nature. The emphasis is on exposing students to a wide range of experiences within each topic of study rather than on the development of technical expertise in one area.

Benefits for Teachers and Students. These materials are designed to assist industrial arts teachers in the classroom as they reinforce and enhance students' skills in reading, mathematics, communication, problem solving, and social interaction. In addition, teachers who use this curriculum material will be able to help their students gain an understanding of and an appreciation for management and work skills needed by indi-

viduals in the world of work. The broad exposure students receive in each topic of study will assist them in making meaningful career choices.

Flexibility of the Materials. This curriculum material, like any other material, cannot encompass all situations. Therefore, teachers should feel free to supplement this material with other ideas, information, or activities needed in their particular programs.

This material can be used in a number of different ways by industrial arts teachers. Some teachers may desire to use it as the starting point, a foundation on which to build their own courses of study. Other teachers may prefer to teach the material as it is and add to it as they feel the need. Still other teachers may pick and choose only selected parts of this curriculum for use in their classes.

Teachers may also need to make substitutions in the curriculum depending on the equipment or references available. Other circumstances may also require teachers to make curriculum substitutions. The flexibility of this material enables teachers to use it in various ways and under various conditions. This curriculum provides teachers with an alternative in course design.

Competencies. Competencies have been identified for the topic of study. As used in this material, competencies represent skills, knowledge, or attitudes that imply the ability or intelligence to accomplish a task or job. They represent the instructional intent and are stated as specific goals to be achieved. Competencies assist teachers and students in clearly formulating a purpose for learning.

Organization of the Curriculum Material

The material in each topic of study is organized into instructional units. The framework used to develop each unit consists of a number of components. These components focus on (1) outcomes, (2) materials, (3) content, (4) activities, and (5) evaluation. The components are further divided and standardized in each topic of study. An explanation of each part in the instructional unit follows.

Objectives. Objectives have been identified for each instructional unit. The objectives reflect the kind of performance necessary to successfully complete a task or job. These objectives enable a student to attain the stated competencies. Furthermore, each unit's objectives are reflected in the content, student activities, and test for that unit. Objectives help the teacher and student to focus on the important concepts to be learned in each unit. Teachers may want to duplicate the competencies and objectives and give them as handouts to the students.

Key Words: Vocabulary. New words or terms are listed to enable you to help students develop their vocabulary. Some words or terms may be listed in several units because they are used throughout a topic of study. The repetition helps reinforce vocabulary building. You will also find that each of the key words or terms has been **boldfaced** in the sentence outline. A student vocabulary worksheet has been included with each unit.

Teaching Aids. The materials, equipment, and supplies identified will enable the teacher to plan and organize instruction better. Teachers need to review this list of teaching aids before the day of instruction since some substitutions in equipment may be needed under certain conditions. A test key has been included to help the teacher in correcting the unit test.

Each transparency in the unit is also listed and briefly described. Transparency masters are provided at the end of each unit. The transparencies are keyed to a point in the sentence outline where their use is considered most appropriate. In addition to being used as transparencies, the masters may be duplicated and used as student handouts if the teacher so desires. Teachers may design or develop other transparency material that they feel enhances their instruction.

Suggested References. Many of the publications listed are available from textbook publishers. However, the reading level of these textbooks is often above junior high/middle school grade level. The materials listed in this section are suggested for use by teachers as a way to supplement their knowledge in the subject area. Teachers can review these references and use selected materials as supplements to their lectures and demonstrations when appropriate. Some of the sources suggested offer free or inexpensive materials that teachers may use with their students.

Sentence Outline. The information presented in this section represents the conceptual focus for the unit. The ideas and concepts are presented in a sentence outline, as a guide from which to teach. The outline should serve as a reference from which

teachers can provide instruction. The intent was not to needlessly duplicate material that is readily available to teachers. Rather, the intent was to provide teachers with basic ideas and information that may be less accessible. The suggested references and other resources can be used by teachers to build a knowledge base from which they can synthesize relevant concepts and information. Suggested references can be used to supplement, expand, and clarify learning activities and instruction.

Materials for Students. Suggestions to teachers regarding student materials may also be listed here. Student handout materials, such as worksheets, charts, graphs, and puzzles, are provided at the end of each unit when appropriate. These student handouts immediately follow the suggested student activities section. Handout materials may be reproduced in quantities and given to students.

Suggested Student Activities. The suggested activities are designed to reinforce and provide real applications of the concepts and content within each unit. These activities have been designed to use existing facilities and equipment as much as possible. Another consideration was the cost factor. Suggested activities are designed to require the minimum cost. Each teacher should, therefore, examine the activities and select those which are appropriate for his or her students. Teachers can change or modify the suggested activities if equipment, materials, and funds are not available. Teachers need to be selective in the activities they use since some activities take longer than others. Some are designed for group activity while others are for individual work. The teacher's content emphasis must also be considered. Each of the activities has been designed to reinforce and enhance basic skills that students need in everyday life.

Tests. Each unit has a multiple-choice test to assist teachers in evaluating student achievement. Multiple-choice tests provide certain advantages for teachers in evaluating the teaching-learning process. They do not capitalize on chance answers to the extent that true-false tests do. Careful development of test answers will help teachers evaluate a student's comprehension of important concepts. This also provides teachers with an easy way to assess the effectiveness of their instruction through item analysis.

Written tests are only one method of assessing learning. Teachers will also need to evaluate a student on actual performance in each activity, on abilities, and on general progress toward reaching objectives. Each teacher should develop an evaluation system that provides the most accurate assessment of a student's progress.

Teachers may prefer to develop their own test instruments. However, their test items should focus on the objectives and course content. The test for each instructional unit in this curriculum material does focus on the objectives stated at the beginning of each unit and on the unit content. A test key is also provided in the teaching aids section of each unit for the teacher's use in correcting tests.

Competencies

- Develop an understanding of the basic materials, tools, and equipment used in printing.
- Become familiar with the basic materials, tools, and equipment used in related industries.
- Acquire an awareness of the basic facts and concepts and show an appreciation for and develop basic skills in planning, organizing, and controlling people and materials.
- Acquire an awareness of the basic facts and concepts and show an appreciation for and develop basic skills necessary in:

  —design and layout
  —composition
  —photo conversion
  —image carrier creation
  —image transfer
  —finishing and binding

1 Introduction to Graphic Arts

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. list some of the major developments in the history of printing;
2. define graphic arts; and
3. explain the scope of the graphic arts industry.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

graphic arts	direct or spirit process
Gutenberg	carbon/carbonless paper
type	typewriter

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-A, 2-B, 3-B, 4-C, 5-D, 6-D, 7-C, 8-C, 9-B, 10-D
- Transparencies: You will find transparencies G1-1 through G1-5 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G1-1: Scribes Transcribing Manuscripts
  G1-2: Carving Into Wood to Form Letters and Symbols
  G1-3: Johann Gutenberg Casting Metal Type
  G1-4: Thomas Edison and His Electric Vibrator Needle
  G1-5: The First Typewriter Was Invented in 1867 By Christopher Sholes

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Duvall, J. Barry, et al. Getting the Message, The Technology of Communication. Worcestor, Mass.: Davis Publications, 1981.

Exploring the World of Graphic Communications. Rochester, N.Y., Eastman Kodak Company, n.d.

Swedlow, Robert M. Introduction to Graphic Arts. Chicago, Ill.: American Technical Society, 1979.

SENTENCE OUTLINE

I. Defining graphic arts
   A. **Graphic arts** is a communicative art that deals with all industries, arts, and processes that produce a message with visual images on varied surfaces.
   B. The primary purpose of graphic arts is to create and produce products that will communicate visually.
   C. The world depends upon the graphic arts industry to produce the many products that are used to entertain, inform, and disseminate information. It also depends upon graphic arts to record our present culture in graphic form for historical preservation purposes. The world also depends upon products that depict past cultures.
   D. Newspapers, books, magazines, advertising brochures, and labels are only a few of the graphic arts products. Other nonprinted products are paper bags, towels, dinner napkins, and plain paper. These products can be found everywhere.

II. Scope of graphic arts
   A. The graphic arts industry recognizes the value of high-speed equipment, such as computers, and how they can improve the effectiveness of an area such as composition.
   B. The industry will continue to expand but will have difficulty obtaining raw materials such as paper. The need for graphic arts products will continue to encourage the industry to produce printed products by faster methods than ever used before.
   C. Commercial printing plants, newspapers, book publishers, paper manufacturers and distributors, equipment and chemical manufacturers, and ink manufacturers make up the graphic arts industry.
   D. Each part or aspect of the industry is

an integral phase of the total industry. Without each aspect doing its separate part, the total industry would not be as effective as it is today.

E. The graphic arts industry is now vast and complex. Therefore, it has been found profitable for smaller segments of the industry to appear in business establishments that cater to specific production phases. Examples of these segments are creative artists houses, composition houses, camera work houses, and central printing facilities.

III. Contributions of graphic arts

A. Graphic communication products have contributed significantly to the cultural development of people. They have provided the link between the past, present, and even future lifestyles of the many peoples who have inhabited and may inhabit the earth.

B. Machines have allowed human beings to produce products in a much faster and better way, but in turn have caused many problems.

IV. Graphic arts industry

A. This industry is changing through its products, its methods, speed and quality of production, and its people.

B. Over two million people are employed in this industry. A shortage of qualified management personnel and skilled production workers exists, and wages and salaries are competitive.

C. This industry is growing because it is highly competitive. There is also a specific ranking of various aspects of graphic arts. The industry is also growing because more information is generated daily, each minute of every day. There are many opportunities for individuals to work in the industry of graphic arts. Skill levels range from no required skills for many entry-level positions to very technical and specialized skill levels for professionals who work with sophisticated equipment and processes.

D. The United States Government Printing Office is the largest single printing plant in the world. Almost any type of printing is done through this office.

V. Historical overview of graphic arts

A. Printing is one of the world's largest industries. It directly affects the lives of every one of us. It is so integrated with our everyday educational, industrial, professional, religious, and domestic needs that it is almost impossible to imagine ourselves without it.

B. Yet only a few hundred years ago, printing did not exist. Before business as we know it today, all trading was done by barter within the immediate community. No paper was required. In fact, there was no paper.

C. When merchants of ancient times began to travel by beast and by ship over long distances to pick up goods for trade, it became necessary to have a means of communication. Writing, which had been a classical art used only for classical purposes up until that time, was the means of communication best suited to serve this purpose. So the merchants hired scribes to write communications for them.

D. Sometimes, one of the scribes would sit in the center of a room and read aloud from the master copy of a book, such as the Bible. The others would sit around him and copy word for word as he read. By this means, they could produce as many as 10 or 20 copies of a book a year. This form of mass production occurred in about 1423 (Transparency G1-1).

E. But since the production of hand-lettered manuscripts was distinctly limited, people began looking for quicker methods of reproducing the needed books. At first, they tried carving the lettering for an entire page on a block of wood. The block was then inked, and proofs were pulled from it. This greatly increased the number of copies that could be reproduced, but it also had many disadvantages. Long, tedious hours went into cutting the blocks. Once the required number of copies had been printed, the blocks were of no further use (Trans. G1-2).

F. In 1454, Johann **Gutenberg** invented a mold for casting separate metal letters, called **type.** These raised letters could be combined or "set" to form words and lines. When enough lines had been set to fill a page, they were put in a press, inked, and printed or impressed on paper. After the required number of impressions had been

made, the letters were separated and used again in new combinations for setting the next page. Gutenberg's modest invention marked the beginning of printing as we know it today (Trans. G1-3).

G. In 1880, Alexander Shapiro found an aniline dye that could be used to duplicate handwriting. It was the beginning of the aniline dye process so widely used in business at the present.

A master (original) bearing an aniline dye deposit was pressed against a roll or film that consisted of a semisolid solution of gelatin, glycerine, and glue. This solution was able to pick up the aniline dye deposit off the surface of the master, retain it on its surface after the master had been removed, and give up a portion of the dye deposit to sheets of paper placed in contact with the gelatin roll.

The master was placed (face down) with the gelatin roll or film on the duplicator, and the gelatin composition removed almost all the dye from the master. The result was a negative or mirror image on the gelatin surface. Copies were reproduced by laying sheets of copy paper on this surface, each sheet removing a small portion of the dye and producing a positive copy.

H. A more recent development supplementing the gelatin process is called the liquid **direct** or **spirit process.** Copies are made directly from the master rather than through a transfer medium, such as the gelatin roll or film. The dissolving agent is direct process fluid. The fluid moistens the copy sheet just before it comes in contact with the master. The moist sheet dissolves a small amount of the dye from the master, producing the copy.

The carbon impression on the reverse side of the master takes the form of a raised letter. The height of this raised letter represents a deposit from which 300 or more bright copies can be reproduced. Each time a copy sheet is pressed against the master, it removes a tiny layer of carbon originally representing 1/300 part of the deposit. This tiny layer of carbon is reproduced on the copy sheet to form an impression.

I. Also in the year 1880, the first **carbon paper** was made. It was not the kind of carbon paper we have today, but an oily piece of paper covered with lampblack. It did not produce particularly good copies, but it served a need. Business offices began to use it in increasing quantities. Today, the carbon paper industry is highly technical and does millions of dollars worth of business annually.

J. It all began with a soot-covered piece of oily paper in 1880. Carbon paper is the duplicating medium depended upon by manufacturers of business forms today. Another type of paper that does not require a carbon sheet to transfer the image, **carbonless paper,** is also widely used today.

K. Following in rapid succession, stencils for duplicating many copies of written information were developed in both America and Europe.

L. The first stencil accepted generally by American business concerns was developed by Thomas Edison. In order to write on these stencils, Edison developed an electric vibrator needle which perforated the stencil. Through these perforations, the copy paper drew ink by capillary attraction, thereby making copies from the stencil (Trans. G1-4).

Incidentally, the electric vibrator needle invented by Edison contained the first electric motor ever manufactured and sold commercially. Over 60,000 of these were sold, an indication of the number of business firms that demanded duplicating to profitably conduct their business organizations over 80 years ago. No electric power plants were available in those days, so these small motors were individually powered by a galvanic battery. This battery was another important invention that had its first wide commercial use in supplying duplicated material to business offices. Among his many other inventions, Edison also developed the first office duplicating machine in the 1880s.

M. The first application of the **typewriter** to duplicating processes was brought

about by "cutting" a stencil with a typewriter equipped with "pinpoint" type (Trans. G1-5). The results were far better than those obtained using stencils prepared by hand. Today, typewriting and duplicating are two basic necessities in every size and type of business enterprise.

N. Printing has come a long way since the fifteenth century. Through the years, it has grown in stature and importance and has now become an expansive modern industry. But modern production requires a speed and accuracy unknown to the early printers. In efforts to meet these demands, several different methods of producing copies have been developed.

SUGGESTED STUDENT ACTIVITIES

1. Define graphic arts.
2. List the main purpose of graphic arts.
3. Suggest different ways in which graphic arts has influenced society.
4. Identify several types of business enterprises that make up the total graphic arts industry.
5. List several early, significant events that led to the development of graphic arts technology.
6. Discuss either orally or in writing why the graphic arts industry is considered a growth industry.
7. Summarize the overall graphic arts processes, and discuss the overview.
8. Develop a timeline of events that shows various inventions, developments, and improvements in this industry.

Vocabulary Worksheet

1. graphic arts

2. Gutenberg

3. type

4. direct or spirit process

5. carbon paper

6. carbonless paper

7. typewriter

TEST

UNIT 1: Introduction to Graphic Arts

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. One of earliest means of mass-producing written materials was by—

A. scribes who copied word for word as another person read
B. printing newspapers
C. printing magazines
D. printing books

___ 2. Block printing was used to make prints by carving into—

A. rocks
B. wood
C. paper
D. plastic

___ 3. The casting of metal letters, or type, was invented by—

A. Alexander Shapiro
B. Johann Gutenberg
C. Christopher Sholes
D. Thomas Edison

___ 4. Movable type was invented in—

A. 1253
B. 1353
C. 1454
D. 1553

___ 5. The first American business stencil was invented by—

A. Alexander Shapiro
B. Johann Gutenberg
C. Christopher Sholes
D. Thomas Edison

___ 6. Graphic arts is described as a communicative art that deals with—

A. industries that produce a visual message
B. arts that produce a visual message
C. processes that produce a visual message
D. all of the above

___ 7. The graphic arts industry employs over—

A. 20 million employees
B. 200 million employees
C. 2 million employees
D. 2 billion employees

___ 8. The largest single printing plant in the world is—

A. the Yellow Pages
B. Sears, Roebuck and Company
C. U.S. Government Printing Office
D. IBM

___ 9. The graphic arts industry is—

A. not highly competitive
B. highly competitive
C. an industry of the past
D. all of the above

___ 10. The graphic arts industry is made up of—

A. printing plants, newspapers
B. book publishers, distributors
C. newspapers
D. all of the above

SCRIBES TRANSCRIBING MANUSCRIPTS 1423 A.D.

CARVING INTO WOOD TO FORM LETTERS AND SYMBOLS

JOHANN GUTENBERG CASTING METAL TYPE 1454 A.D.

THOMAS EDISON AND HIS ELECTRIC VIBRATOR NEEDLE. 1880's

20

G1-4

THE FIRST TYPEWRITER WAS INVENTED IN 1867 BY CHRISTOPHER SHOLES.

2 Printing Processes

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. list and define the six major methods of graphic reproduction;
2. explain which elements are used with each method of graphic reproduction; and
3. demonstrate knowledge of the laboratory safety policies in writing or orally.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

relief printing	electrostatic printing
gravure printing	planographic printing
screen printing	photographic printing

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-C, 2-A, 3-A, 4-B, 5-D, 6-A, 7-C, 8-D, 9-C
- Transparencies: You will find transparencies G2-1 through G2-6 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G2-1: Relief Printing Uses Raised Type
  G2-2: Gravure Printing Uses Images Below the Surface
  G2-3: Screen Printing Process
  G2-4: Electrostatic Printing
  G2-5: Planographic Printing
  G2-6: Photographic Printing

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Basic Printing Methods. GA-11-1. Rochester, N.Y., Eastman Kodak Company, n.d.

Broekhuizen, Richard J. Graphic Communications. Bloomington, Ill.: McKnight Publishing Company, 1979.

Walker, John R. Graphic Arts Fundamentals. South Holland, Ill.: Goodheart-Willcox Company, 1980.

SENTENCE OUTLINE

I. Types of printing processes
In order for society to communicate visually, a major portion of material is printed by one process or another. To produce the variety, quality, and quantity of printed material that society demands, the printing industry uses a series of processes. Each of these processes is able to satisfy certain demands. The six major methods of graphic reproduction are as follows: (1) **relief**, (2) **gravure**, (3) **screen**, (4) **planographic**, (5) **electrostatic**, and (6) **photographic printing**.

A. **Relief printing**
Relief printing is commonly referred to as letterpress printing in the industry. It refers to the reproduction of a printed piece from type or engravings that have been made in relief. A piece of type, for example, has a printing surface that is in relief, or raised above the body of the type character. When the surface has been inked, the design may be transferred to the paper by applying pressure. Typical relief printing media are the rubber stamp, type, and the typewriter (Transparency G2-1).

B. **Gravure printing**
Gravure printing is the reverse, or opposite, of relief printing. The image is actually below the surface of the printing plate. After ink is applied to the entire plate surface, the excess ink is wiped off, leaving a deposit of ink in the depressions. The ink is transferred to the paper by placing pressure against the sheet in contact with the plate. The gravure printing process is commonly referred to as intaglio printing (Trans. G2-2).

C. **Screen printing** (silk screen)
Screen process printing is one of the newest and most rapidly growing graphic arts processes. In this pro-

cess, stencils are either hand cut or produced photographically and attached to silk, which is stretched tightly across a frame. Ink is then forced through the open areas of the stencil onto the paper by means of a squeegee (Trans. G2-3).

D. **Electrostatic printing**
In electrostatic printing, the image is transferred to the paper by electrostatic attraction. Because of the electrical charges, the ink actually jumps from the plate to the paper. This process is very different from the exertion of terrific pressure on the gravure plate and cylinder in contact with the paper to create the necessary capillary action (Trans. G2-4).

E. **Planographic printing**
Planographic printing refers to reproductions made from a plate on which the image and the nonprinting surfaces are on the same plane. The principle of operation is the fact that ink and water do not mix. Ink is transferred to a rubber blanket, from which the actual printing is done. This process is commonly referred to as lithography, lithographic printing, offset, or photooffset (Trans. G2-5).

F. **Photographic printing**
Basically, the process of photography involves the use of reflected light from an object to expose a light-sensitive material called film. From the film, negatives are produced. The negatives can be made into prints, which are called pictures. The negatives can also be used to make printing plates for the purpose of printing a large number of copies (Trans. G2-6).

II. Graphic arts laboratory safety

The following are laboratory policies that must be observed in the graphic arts laboratory to protect yourself and others from injury. Before any work can be done in the laboratory, you must be able to demonstrate your knowledge of these policies in writing or orally:

A. Obtain the instructor's permission before operating any equipment in the laboratory.
B. Place all rags containing solvents, oil, or ink in the metal safety cans.
C. Remove all jewelry, such as rings and watches, before operating any machine.
D. Keep ties, shirttails, and shirt-sleeves tucked in or rolled up.
E. Report all accidents and injuries to the instructor for immediate attention.
F. Keep all guards in place when using any piece of equipment.
G. Report all broken, dull, or damaged tools to the instructor.
H. Never lubricate or adjust any machine while it is running.
I. Never leave a machine running while it is unattended.
J. The operator of any machine should not engage in conversation with anyone while operating that tool or machine.
K. Only one person is allowed within the safety zone of any machine.
L. Keep the laboratory work areas, machines, and floors clean and unobstructed.
M. Leave the room immediately upon hearing the fire drill evacuation signal.
N. Running and horseplay are not permitted.
O. Do not carry tools with sharp points or edges in your pockets.

MATERIALS FOR STUDENTS

- Student notebooks
- Newspapers, magazines, any printed material
- Sketch paper
- Safety handout

SUGGESTED STUDENT ACTIVITIES

1. Have students begin a notebook that will be used throughout the course to collect examples of the various printing processes.
2. Have students collect examples of each of the major printing processes.
3. Have students compare and contrast the various printing process surfaces for rubber stamps, relief (offset), planographic printing, and so on.

For example:

Comparison Listing

Processes	Examples
(1)	(1)
(2)	(2)
(3)	(3)

4. Have students sketch models representing the various printing processes.
5. Students should learn the Graphic Arts Laboratory Safety Rules and be able to list them orally or in writing.
6. Have students make an oral or written report on one of the printing processes.
7. Bring printed examples to class, and have students discuss which process was used to produce each.
8. Have students define the various terms used in printing (see Vocabulary Worksheet).

Vocabulary Worksheet

1. relief printing

2. gravure printing

3. screen printing

4. electrostatic printing

5. planographic printing

6. photographic printing

TEST

Unit 2: Printing Processes

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Relief printing is commonly referred to as—

A. gravure printing
B. screen printing
C. letterpress printing
C. intaglio printing

___ 2. Gravure printing is the reverse or opposite of—

A. relief printing
B. intaglio printing
C. screen printing
D. planographic printing

___ 3. Gravure images are—

A. below the surface of the printing plate
B. above the surface of the printing plate
C. surfaceless
D. all over the surface of the printing plate

___ 4. Screen printing stencils are—

A. either hand cut or produced planographically
B. either hand cut or produced photographically
C. either hand cut or produced electrostatically
D. either hand cut or produced by machine

___ 5. Electrostatic printing images are transferred to the paper—

A. by exerting a terrific pressure
B. by cylinder contact
C. planographically
D. by electrostatic attraction

___ 6. Planographic printing refers to reproductions made from a plate on which the image and the nonprinting surfaces are—

A. the same
B. on different levels
C. all raised
D. all recessed

___ 7. Planographic printing is based on the fact that ink and water—

A. mix easily
B. are liquids
C. do not mix
D. are not flammable

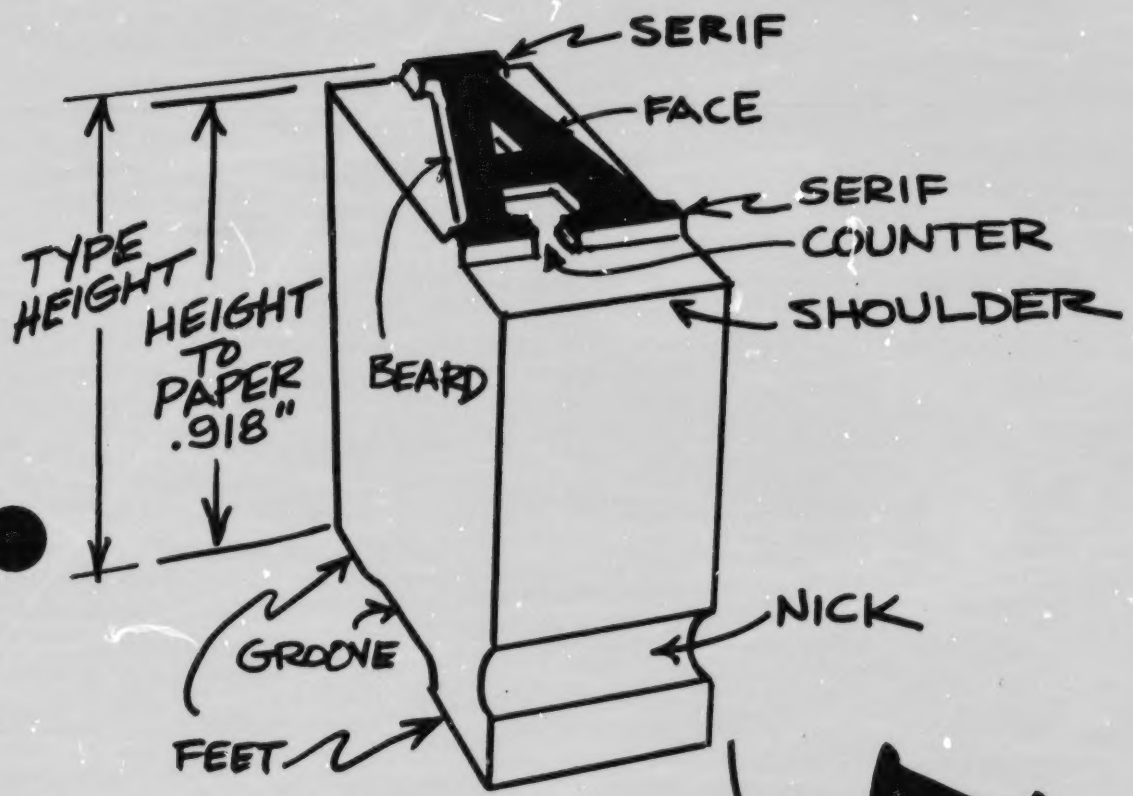
___ 8. Planographic printing is commonly referred to as—

A. lithography or lithographic printing
B. offset
C. photo-offset
D. all of the above

___ 9. Photographic printing uses a light-sensitive material called—

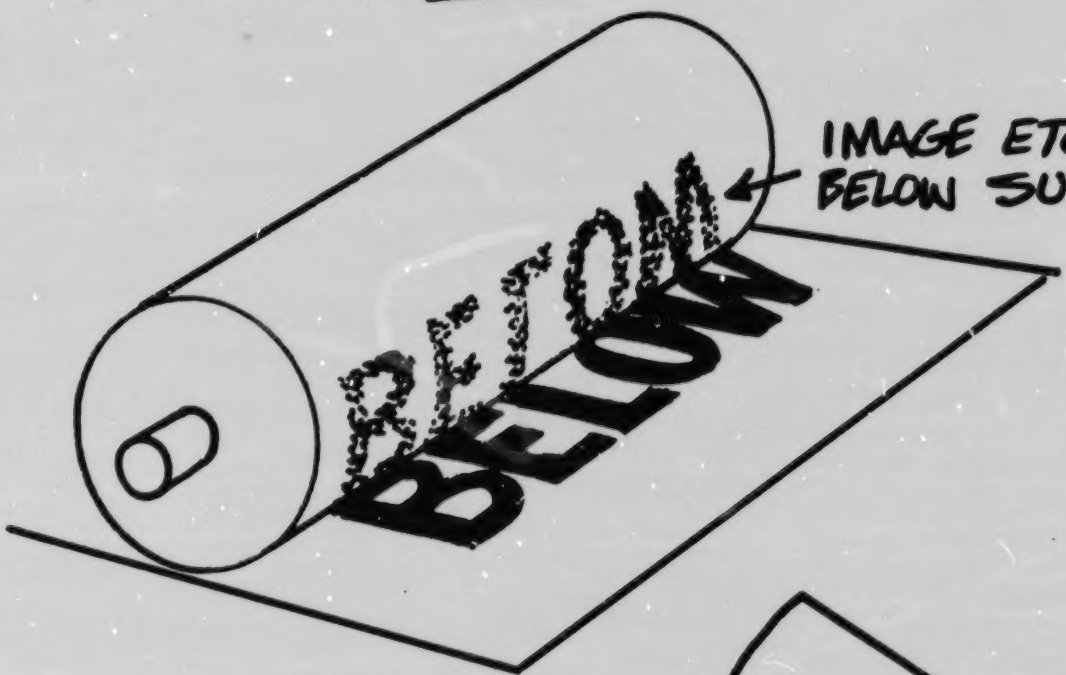
A. developer
B. camera
C. film
D. reflected light

RELIEF PRINTING USES RAISED TYPE.

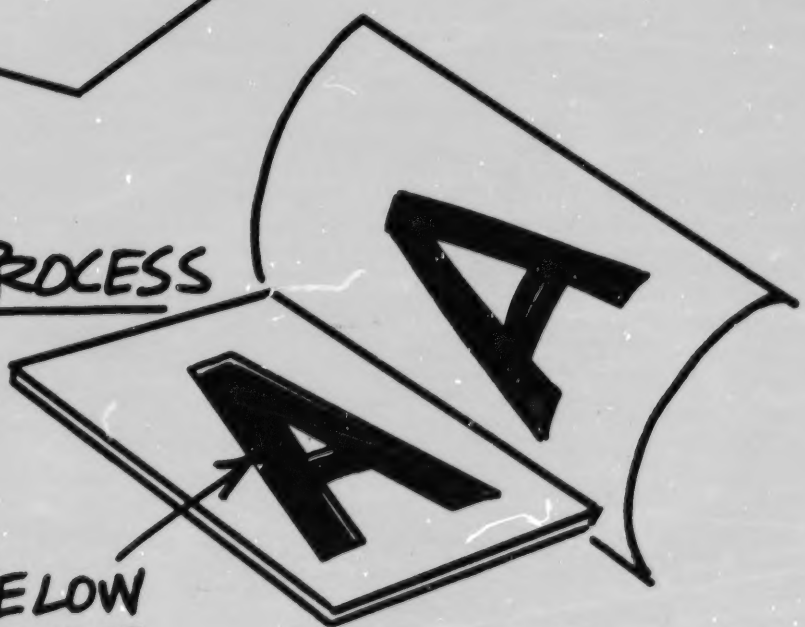


LETTERPRESS PROCESS

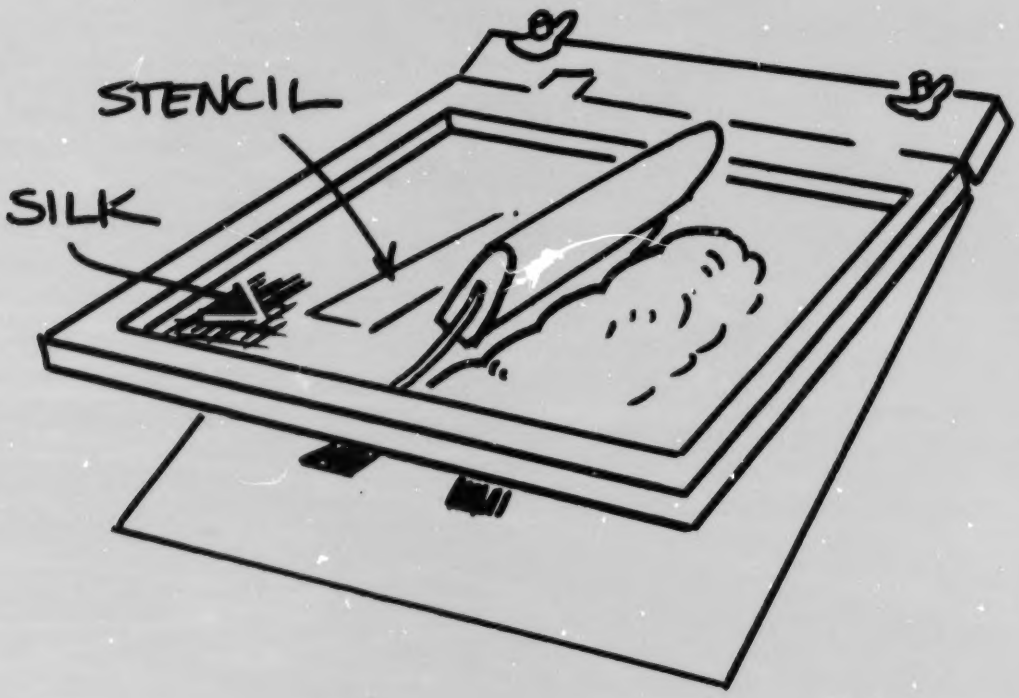
GRAVURE PRINTING USES IMAGES BELOW THE SURFACE.



INTAGLIO PROCESS

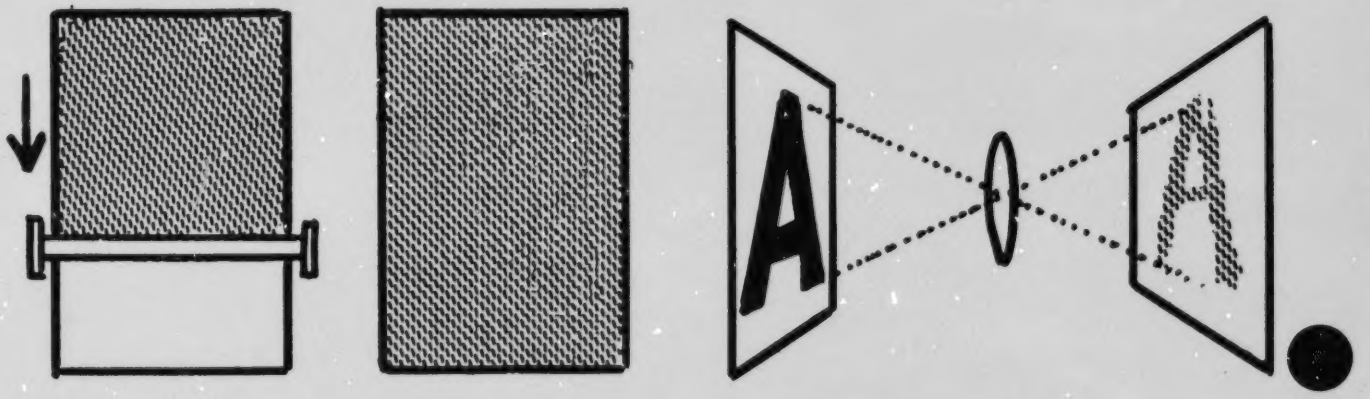


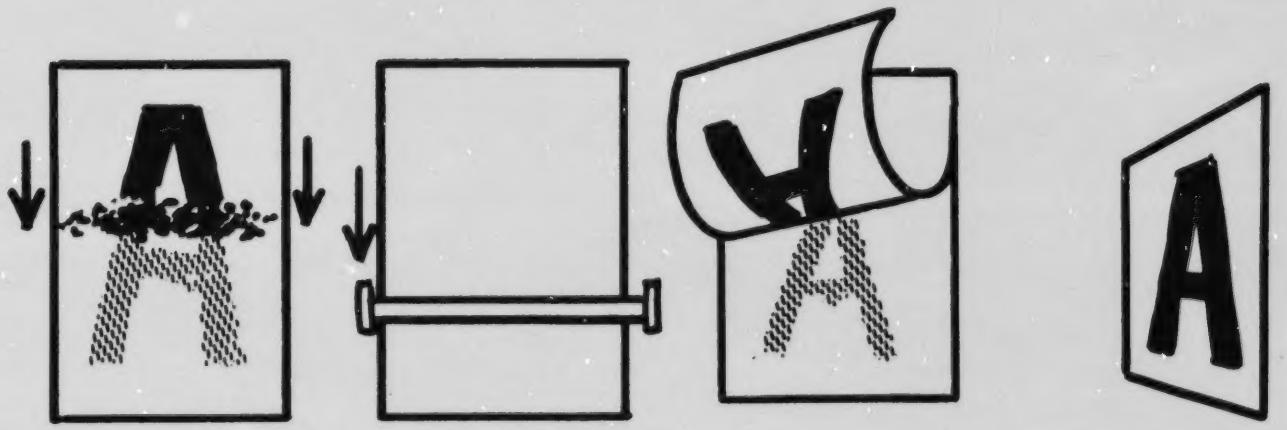
SCREEN PRINTING PROCESS



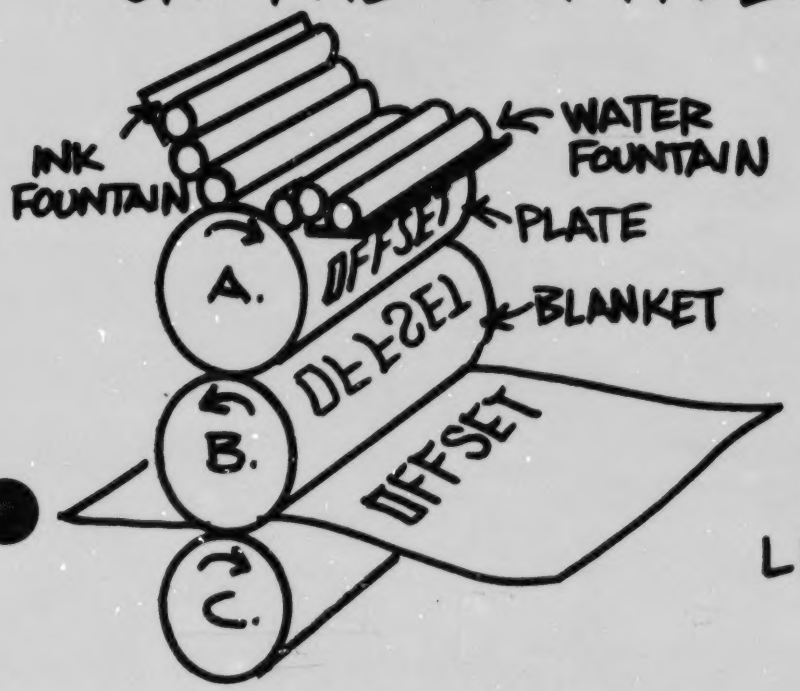
ELECTROSTATIC PRINTING

USES AN ELECTRICAL CHARGE TO THE IMAGE WITH A POWDER; THEN IT IS HEATED.



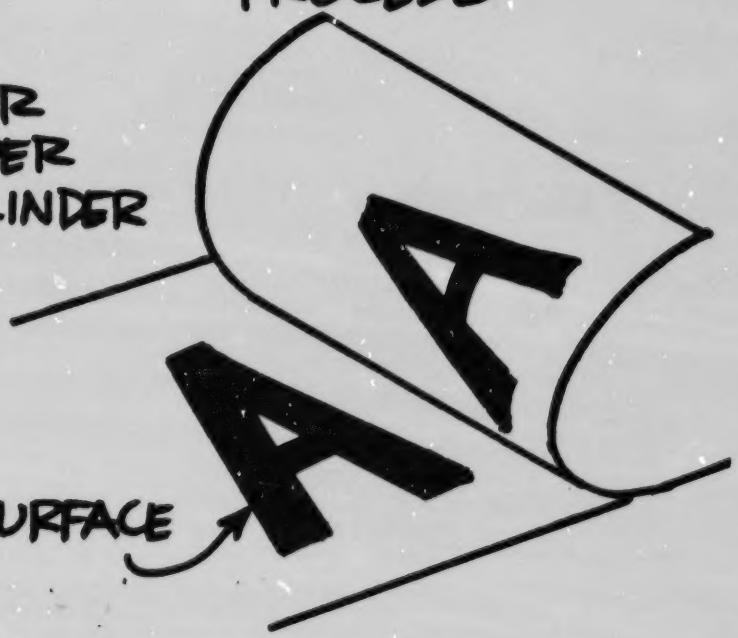


PLANOGRAPHIC PRINTING
USES AN IMAGE THAT IS ON THE SURFACE.



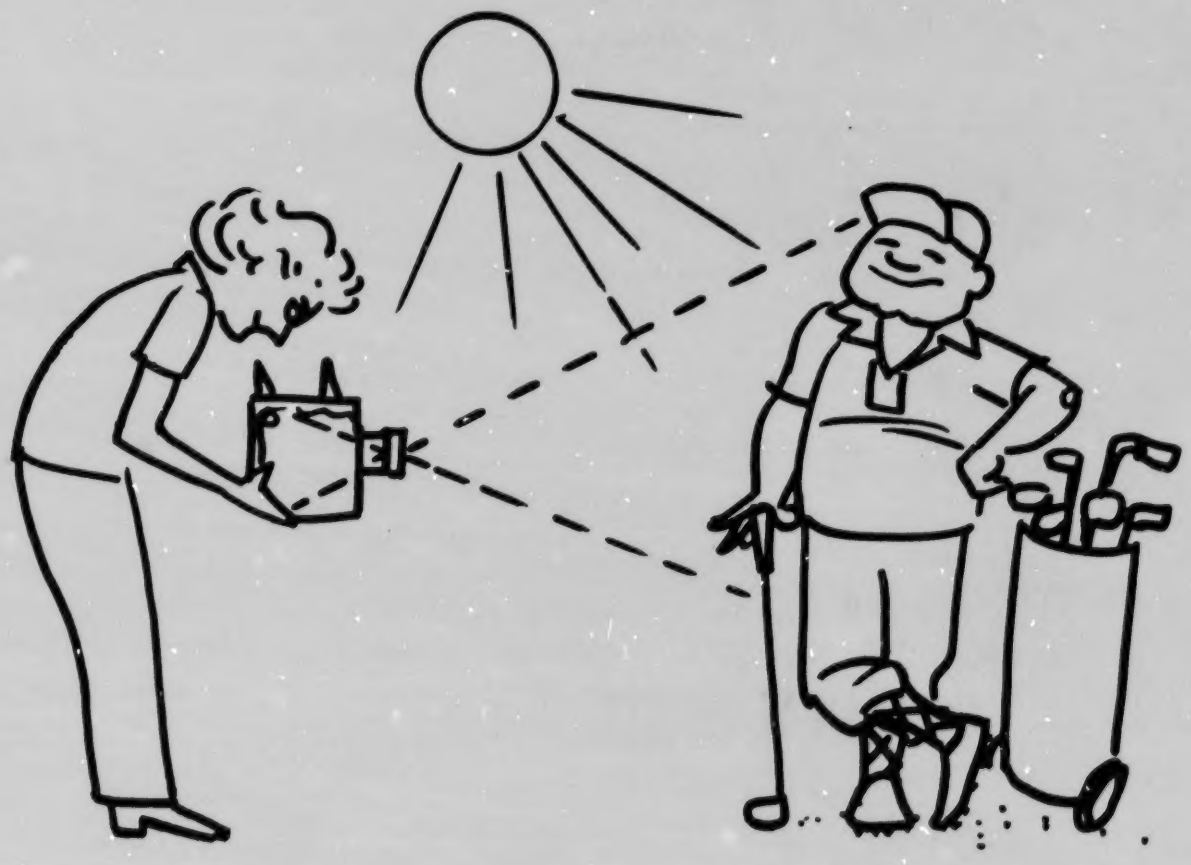
A. PLATE CYLINDER
B. BLANKET CYLINDER
C. IMPRESSION CYLINDER

LITHOGRAPHIC PROCESS



PHOTOGRAPHIC PRINTING

LIGHT IS REFLECTED
FROM SUBJECT TO FILM.



3 Layout and Design

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define layout and a printer's layout;
2. list and explain the five basic principles of design; and
3. demonstrate layout and design techniques.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

layout	rhythm
formal/informal layout	unity
proportion	rough/finished layout
symmetrical	balance
	contrast

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Examples/slides of basic design principles
- Test Key: 1-D, 2-D, 3-A, 4-A, 5-D, 6-D, 7-A, 8-A
- Transparencies: You will find transparencies G3-1 through G3-6 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G3-1: Proportion
  G3-2: Balance
  G3-3: Contrast
  G3-4: Rhythm
  G3-5: Unity
  G3-6: Printer's Layout

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Carlsen, Darvey. Graphic Arts. Peoria, Ill.: Charles A. Bennett Company, 1977.

Graphic Design. GA-11-Z. Rochester, N.Y., Eastman Kodak Company, n.d.

Silver, Gerald. Graphic Layout and Design. Albany, N.Y.: Delmar Publishers, 1981.

SENTENCE OUTLINE

I. Understanding layout and design
   A. **Layout** is a method of applying design to printing. A layout is an arrangement of all component parts of the printed matter, such as headlines, subheadings, body copy, and illustrations or cuts, in an attractive pattern. The layout is used in production printing as a blueprint from which all specifications and requirements are obtained.
   B. All successful layouts must be built on sound structural lines and on certain fundamental principles. Although the style of printed material may change from year to year, the fundamentals of good design remain the same.
   C. Two distinct layout styles are commonly used. These are **formal** and **informal layout.**
   D. The formal layout is symmetrically balanced. This means that all elements on the printed copy are absolutely centered within the area, or **symmetrical.** If a vertical line is drawn through the center of the area, one half of each element will appear on either side of the line. This layout style is generally used when an impression of order and quiet is desired. Since formal layout is conservative and dignified in nature, it is very appropriate for insurance companies, banks, and professional organizations.
   E. Informal layout, on the other hand, gives the impression of movement and action since it is nonsymmetrical. The printed areas in the informal layout are not centered within the area. However, there is still optical balance. This may be accomplished by dividing the white space into interesting geometrical shapes and by using tones that create contrast. Informal layout is used to attract attention, invite interest, and to stimulate the reader to some type of action. Informal layout is generally used for such things as travel posters, theater advertise-

ments, and fashion layouts.

F. The five basic principles of design are **proportion, balance, contrast, rhythm,** and **unity.** These should not be thought of as rigid rules that dictate the layout process. However, with a fundamental understanding of the purpose of these design principles, it is possible to use them as guides in design and layout.

II. **Proportion** (Transparency G3-1)

A. By definition, proportion means the relationship of one part to another part, or to the whole. Here, proportion means the relationship of one image element to another.

B. Being influenced by a naturally developed sense of correct proportion, the eye reacts favorably to layouts that are well proportioned and rejects those whose mathematical dimensions are too obvious.

C. In a square, the four equal sides may be said to be harmoniously related, or evenly balanced. However, the obvious mathematical shape of the area is static, monotonous (boring), and uninteresting. The eye quickly rejects the square because of the equality of the dimensions. Likewise, the eye rejects any rectangular shape if one dimension is an easily recognized multiple of the other dimensions.

D. Therefore, the basic rule for obtaining good proportion is to regulate the dimensions so that the eye does not easily perceive their mathematical relationship.

III. **Balance** (Trans. G3-2)

A. Balance can be divided into two types. Formal balance is attained when all the units are centered or arranged so that half of each unit falls on each side of an imaginary line drawn through the middle of the layout. Informal balance has the individual layout units positioned off center.

B. When using informal balance, the total layout must present a state of equilibrium, or be controlled. In other words, the weight of the printed matter on one side of the page must be balanced by the printed matter on the opposite side.

IV. **Contrast** (Trans. G3-3)

A. Contrast as a design principle gives life and variety to a layout. By relieving the monotony with contrast, the layout becomes interesting and appealing to the eye. Contrast, when applied properly, emphasizes the major element of the layout. This element may be a picture, trademark, single word, or a slogan.

B. To make the major element stand out in display lines, one of the following techniques is generally used:

1. underscoring
2. larger typeface
3. italic type
4. bold type

C. Contrast can also be used to make an element strikingly apparent by using color. This can be done by using a bright color, such as red, for the major element and using a softer color for the rest of the layout.

V. **Rhythm** (Trans. G3-4)

A. Rhythm gives action and interest to the layout. Rhythm is the design principle that carries the eye from one item to the next in a logical progression.

B. When reading, the normal direction of eye travel is from top left to bottom right. When the layout contains all text material and has no pictures or illustrations, the principle of rhythm is automatic. However, when several illustrations are used with the text material, the eye may become confused and not move from one illustration to the next in a logical progression.

C. To give direction to the eye in such a layout, several techniques may be used. For example, a vertical band or line may be used to lead the eye in an upward or downward direction, while a horizontal band or line will direct the eye to the right or to the left.

VI. **Unity** (Trans. G3-5)

A. Unity is the quality that holds the layout together. Unity keeps the units related and orderly.

B. In a layout that contains all text material, unity is achieved by grouping related material and eliminating unnecessary initial letters, paragraphs, and variations in type size and style.

C. When illustrations are used in conjunc-

tion with text material, unity can be achieved by grouping related material that has common interest and importance.

VII. **Printer's layout** (Trans. G3-6)

A. A printer's layout can be compared to a construction worker's blueprint. A finished layout should contain all the necessary information that is required to complete a printed job.

B. The first step is to make the **rough layout.** The rough layout is used to explore the various possibilities for positioning the required copy. Generally, these sketches show the size, shape, form, and organization of the copy. On the rough layout, it is not necessary to letter the copy or to indicate the final selection of color or type. As a general rule, the rough layout will contain lightly shaded rectangular areas indicating small type and dark, shaded areas indicating bold type. In both cases, the size of the shaded areas should be about the same size as the type.

C. From the rough layout, the **finished layout** can be prepared. The following are rules that should be kept in mind when preparing a finished layout:

1. The finished layout should be done on paper that is larger that the finished piece. This provides space in the margin for notations, such as the size and kind of paper and the color of ink to be used.
2. The finished layout should be prepared at actual size on the kind and color of paper that the job will be printed on.
3. Indicate on the layout the style, size, and location of the type and the color of ink to be used.
4. If at all possible, the finished layout should be made in the color of the ink to be used on the printed copy.
5. If a cut is used, its location, size, and color must be indicated on the finished layout. If a proof of the cut is available, it is recommended that it be pasted on the layout in the proper position. If a proof is not available, a sketch of the cut should be on the layout.
6. If a multicolor layout is made, separate overlay sheets for each color should be made.
7. "Crop marks" or register marks should be on the overlay sheets for a multicolor layout. These marks, when lined up, give a true picture of the layout with colors and positions in register.
8. Any notations on the layout, such as type size, type style, size of paper, and number of sheets to be printed should be made in blue.

MATERIALS FOR STUDENTS

- Newspapers
- Magazines
- Any available printed material

SUGGESTED STUDENT ACTIVITIES

1. Have students go through newspapers or magazines, and select examples of each basic design principle.
   - Proportion
   - Balance
   - Contrast
   - Rhythm
   - Unity
2. Have students make rough and finished layout designs for each printed project throughout the course.
3. Have students bring business cards and mount or file them.

Vocabulary Worksheet

1. layout

2. formal layout

3. informal layout

4. proportion

5. balance

6. contrast

7. rhythm

8. unity

9. rough layout (thumbnail sketch)

10. finished layout

11. symmetrical

TEST

Unit 3: Layout and Design

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: _C_ 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. A layout is an arrangement of —

A. subheadings
B. headlines
C. body copy
D. all component parts of the printed matter

___ 2. Two distinct layout styles in common use are—

A. balanced and proportional
B. isometric and oblique
C. conservative and dignified
D. formal and informal

___ 3. Good proportion is—

A. the regulation of the dimensions to please the eye
B. strict mathematical dimensioning
C. strict geometrical dimensioning
D. not pleasing to the eye

___ 4. Balance is divided into two types—

A. formal balance and informal balance
B. proportional balance and nonproportional balance
C. centered balance and off-centered balance
D. weighted balance and nonweighted balance

___ 5. Contrast techniques are the use of—

A. underscoring or underlining
B. larger typeface or color
C. italic type or bold typefaces
D. all of the above

___ 6. Rhythm is the design principle that carries—

A. the theme of the printed matter
B. the color scheme
C. the weight of the paper
D. the eye from one item to the next in a logical progression

___ 7. Unity—

A. holds the layout together
B. is the type style used
C. always includes illustrations
D. only includes the text of the material

___ 8. A printer's layout includes—

A. a rough and a finished layout
B. only thumbnail sketches
C. only the final dimensions
D. only the type styles used

PROPORTION

THE RELATIONSHIP OF SIZES

A.

B.

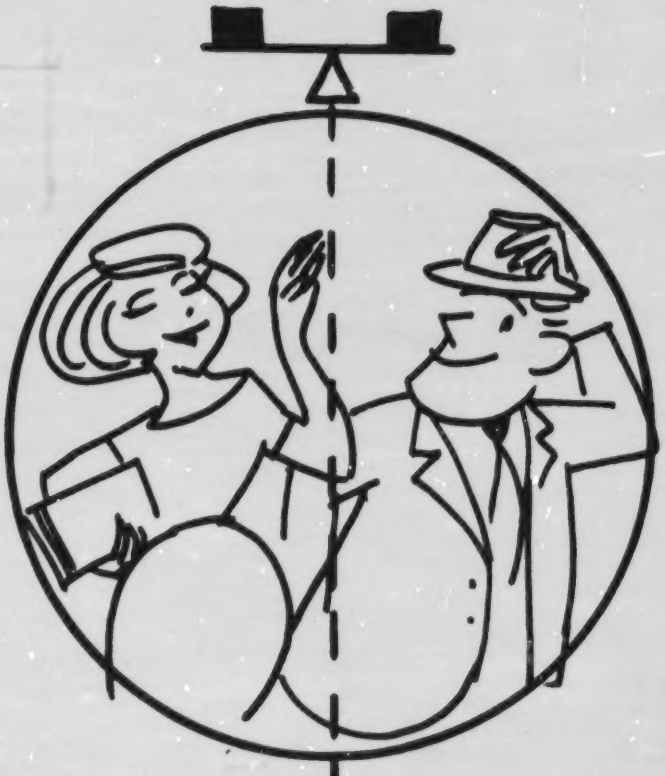
C.

A. OUT OF PROPORTION - WORM TOO SMALL

B. IN PROPORTION - APPLE AND WORM RIGHT SIZE FOR EACH OTHER.

C. OUT OF PROPORTION - WORM TOO LARGE.

BALANCE



FORMAL BALANCE

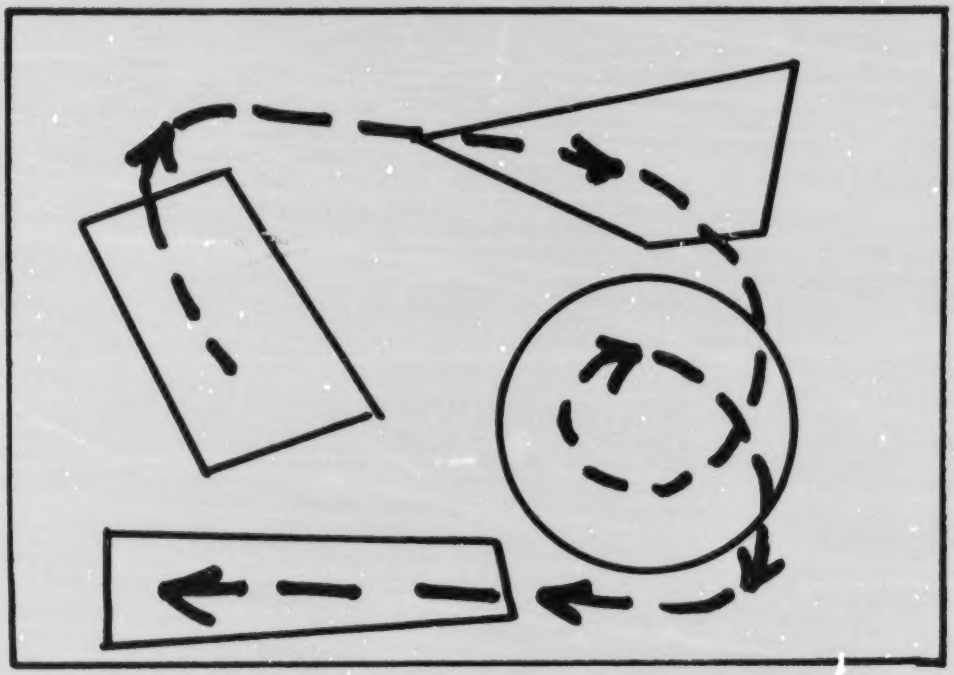
INFORMAL BALANCE

CONTRAST - GIVES LIFE AND VARIETY TO A LAYOUT.

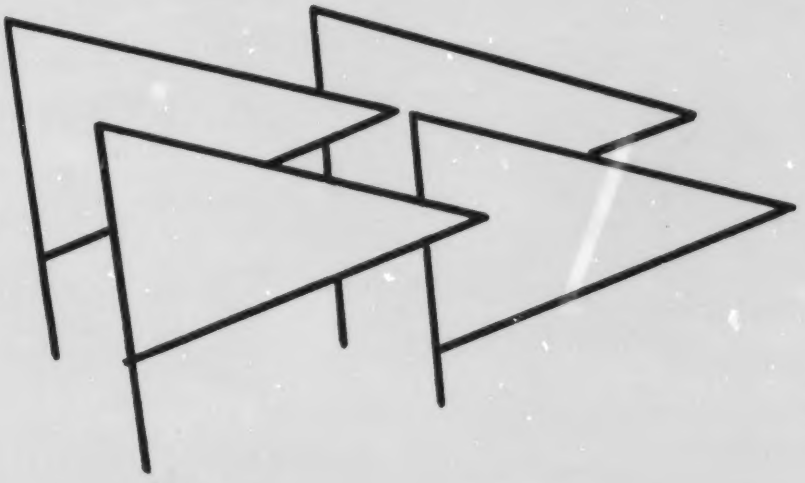
TWELVE WAYS TO EMPHASIZE WITH TYPE:

1. Change the SIZE.
2. Use CAPITAL letters.
3. Use SMALL CAPITAL letters.
4. Use *italic* type.
5. Use a different kind of type.
6. Change the face.
7. Underline words.
8. Use eye-directing → symbols ← .
9. Alter the position.
10. Enclose [word(s)] with lines.
11. Use COLOR when possible.
12. Reverse **type** .

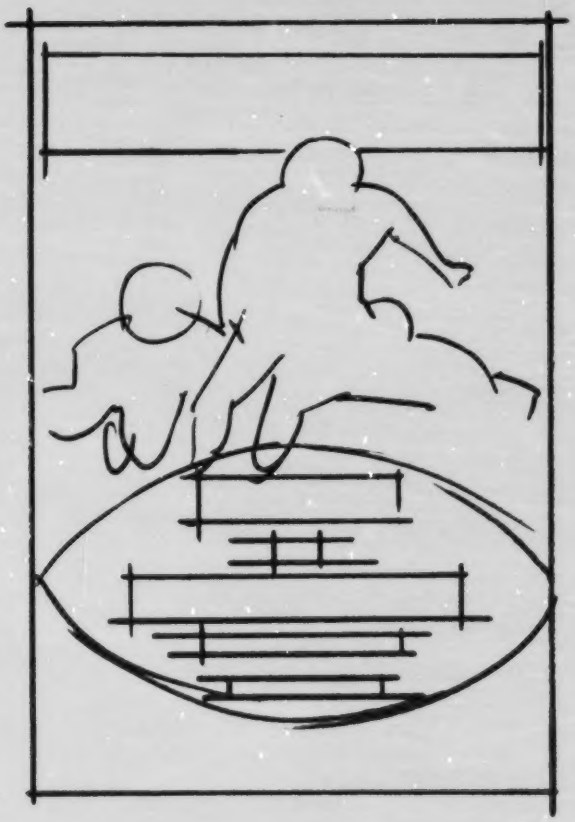
RHYTHM - MOVES THE EYE IN THE DIRECTION THE DESIGNER WANTS IT TO GO.

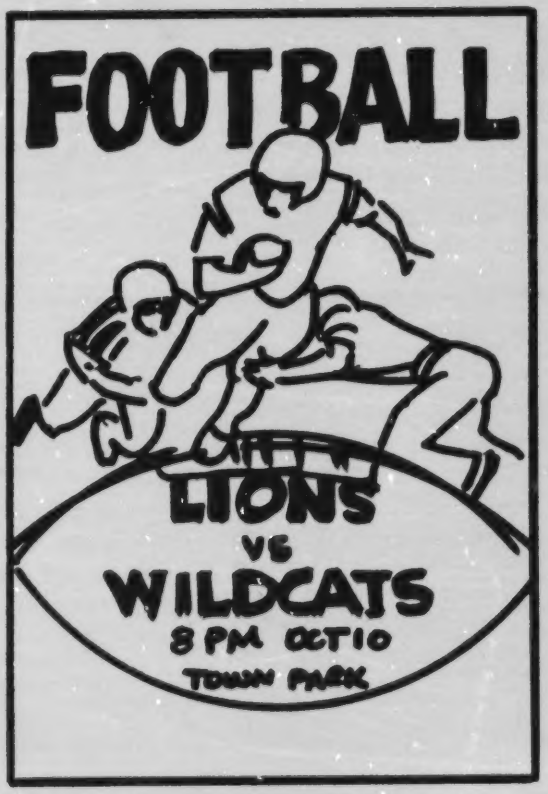


UNITY - MAKES DIFFERENT ELEMENTS LOOK LIKE THEY BELONG TOGETHER



PRINTER'S LAYOUT:
ROUGH AND FINISHED





4 Relief Printing

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify and name the basic relief printing equipment;
2. explain the printer's point system;
3. identify and explain the purpose of the California Job Case;
4. identify the methods of reproducing linoleum block design; and
5. demonstrate the process of making rubber stamps.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

type bank/cabinet
imposing table
proof press
galley
brayer
lead
slug
composing stick
printer's point system
pica
points
California Job Case
demon characters
spaces
quads
proofing
linoleum block
font
line gauge
mitering machine

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-D, 2-C, 3-A, 4-B, 5-C, 6-B, 7-A, 8-B, 9-C, 10-C, 11-D, 12-D
- Transparencies: You will find transparencies G4-1 through G4-11A, B, and C at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

G4-1: Relief Printing Equipment
G4-2: Relief Printing Equipment
G4-3: The Printer's Point System
G4-4A, B: The California Job Case
G4-5: The Demon Characters
G4-6A: Spaces and Quads
G4-6B: Various Leads for Creating Space Between Lines of Type
G4-7: Removing the Case from the Type Bank
G4-8: The Left Thumb Holds the Type in Place
G4-9: Chase and Furniture
G4-10: Transferring the Design to Block
G4-11A, B, and C: Making a Rubber Stamp

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Carlsen, Darvey. Graphic Arts. Peoria, Ill.: Charles A. Bennett Company, 1977.

Dennis, Ervin A., and Jenkins, John D. Comprehensive Graphic Arts. Indianapolis, Ind.: Bobbs-Merrill Educational Publishing, 1983.

Frankenfield, Henry. Printmaking. Audubon, N.J.: Hunt Publishing, 1964.

Kagy, Frederick D. Graphic Arts. South Holland, Ill.: Goodheart-Willcox Company, 1978.

Walker, John R. Graphic Arts Fundamentals. South Holland, Ill.: Goodheart-Willcox Company, 1980.

SENTENCE OUTLINE

I. Relief printing process

A. Relief printing, or printing from a raised surface, is the oldest method of graphic reproduction. The method originated in the Orient, where the Chinese first developed the process over 1,000 years ago. For many years, the relief character had to be hand cut from wood blocks.

It was not until 1453 that Johann Gutenberg, trying to improve the relief process, developed metal movable type. Because of this invention, the speed with which printed matter could be reproduced was greatly increased. The metal type could be reused many times without breaking down, as did woodcuts. However, all printed matter still had to be set by hand.

Today, because of the great demand placed on the printing industry by society, machines, such as the Linotype, have been developed that eliminate most large-scale hand typesetting.

B. The following are names and purposes of the basic relief printing equipment that you will be using. Study and learn each of these:
   1. **Type bank/cabinet** (Transparency G4-1). The type bank/cabinet serves as a storage unit for the California Job Cases. It may also provide slanted work stations for the placement of the cases when setting type.
   2. **Imposing table.** The imposing table is a flat, smooth-top table used for locking up type forms. It is also used as a storage area for furniture and galleys.
   3. **Proof press.** The proof press is used to pull trial prints or proofs of relief printing composition to check for errors.
   4. **Galley** (Trans. G4-2). The galley is a three-sided metal tray used for storage and transportation of type forms.
   5. **Brayer.** The brayer is an ink roller used to ink relief printing matter for proofing on the proof press.
   6. **Lead** and **slug cutter.** The lead and slug cutter is used to cut leads and slugs to the desired length when setting type.
   7. **Composing stick.** The composing stick is an adjustable-measure device used to place type in during composition.
   8. **Mitering machine.** The mitering machine is used to smooth or trim the ends of leads and slugs at 90-degree angles. It is also used to cut 45-degree angles on rule used to meet and form a border around a type form.

C. **The printer's point system** (Trans. G4-3). The **line gauge** is the printer's rule. The most commonly used line gauge is one foot long, with inch graduations along one edge and nonpareil and pica divisions along the other edge. The **pica** is the standard unit of measure on the line gauge. It is equal to one-sixth of an inch. The pica can be subdivided into 12 equal divisions called **points.**

II. **California Job Case** (Trans. G4-4)
   A. Description
      1. The California Job Case is a tray that is divided into small compartments for the storage and transportation of type. Each case holds one **font** of type. A type font is an assortment of one size and face of type which includes capital and lower-case letters, figures, special characters, and punctuation marks.

         The location of the letters is referred to as the "lay of the case." The lay of the case is said to be "dirty" if the letters are in the wrong compartments. It is necessary to keep the case "clean" if good typesetting is to result.
      2. The right-hand third of the case holds the capital letters. These are arranged alphabetically with the exception of the J and U, which come after the Z.
      3. The lower-case letters are placed in the remainder of the case according to frequency of use. The letters that are most often used have a central location and generally have the larger compartment. Mixed in with the lower-case letters are the numbers, punctuation marks, spaces, quads, and ligatures.
      4. A ligature is two or more type characters on one type body. Some of the common ligatures are **ffi, ffl,** and **fl.** These may be used only when there is insufficient space for individual type pieces in the line.
      5. Three "sentences" that may help you in memorizing the positions of lower-case letters are:
         a. **be careful driving elephants into small ford garages**
         b. **let me now help out your punctuation with commas**
         c. **villains usually take 3 em spaces and run**

   B. **Demon characters** (Trans. G4-5).
      As you look at a piece of type, you will notice that it is cast in reverse. For this reason, some type characters appear to be a different letter than they really are. These are called the

demon characters: d, b, p, q, n, u, 6, 9, l, I, 1, o, 0, O, ', and ,

C. **Spaces** and **quads** (Trans. G4-6)
   1. When a line of type is composed, metal spaces must be placed between the words. Spaces are pieces of type metal, but they are shorter than type and have no printing face. Because of this, they do not print, but appear as white space on the printed copy.
   2. The em quad, being square, serves as the basic unit for the rest of the spaces and quads. The 2-em quad is twice as large as the em quad, and the 3-em quad is three times as large. On the other side of the em quad, we find the en quad, which is half the width of the em quad. Quads are generally used for filling in black space at the ends of lines.
   3. The 3-em space is a third of the width of the em quad. It is commonly referred to as the "word space" because it is considered the ideal space to be placed between words. The 4-em space is a fourth the width of the em quad, and the 5-em space is a fifth of the width of the em quad. The 4-em and 5-em spaces are used in spacing out lines of type and for justifying lines of type. Justification is the process of making a line of type tight in the composing stick. The hair space is also used in justifying type. It is used only when all other combinations of spaces and quads fail to make the line tight in the stick.

D. Type composition
   1. When setting type, you must follow your finished layout, which indicates the name and the point size of the type to be used. After locating the proper type case, it can be removed from the type bank. Slide the case out about 10 inches, get a firm hold on it with both hands, and carefully lift it from the type bank (Trans. G4-7).
   2. Place the case on the slanted work surface of the type bank. Make sure it is supported by the rail and that it doesn't hang over the edge. If a case is dropped or spilled, it is referred to as "pied type."
   3. To begin setting type, first, adjust the composing stick to the measure, in picas, that you wish to set the line. The composing stick is always held in the left hand. This leaves the right hand free to pick up the type from the case and place it in the stick.
   4. To set a line of type, insert a slug in the stick that is the same length as the line to be set. Slugs are six points thick and give support to the type form. As each piece is picked up by the right hand, observe the position of the nick and the typeface. The type must be placed in the stick from left to right with the nick up and the typeface pointing out. The left thumb catches and holds each piece of type as it is placed in the stick (Trans. G4-8).
   5. If the line of type characters does not fill the measure, it must be justified in the stick by placing spaces and quads in the blank space. When justifying a form, keep the small spaces to the inside of the line, or next to the type characters. If the line of type is to be centered in the stick, an equal amount of spacing material is placed on each side of the printing type.
   6. A **lead** is placed between each line of type. A lead is two points thick and provides white space between the lines. The lead must be equal to the measure of the line of type.
   7. When the type form is completed, place a **slug** at the bottom. The form must now be placed in a galley and tied with string for proofing or storage.

E. Tying, **proofing**, and storing
   1. Slide the type form from the composing stick into one corner of the galley so that the leads and slugs run parallel to the bottom of the galley. Start the string in the exposed corner of the form, winding it clockwise around the form. Then tuck the end of the string under the windings in the open corner. To reduce the possibility of

"pi," it is recommended that you work on the slanted surface of the type bank.

2. To pull a proof, place the galley on the bed of the proof press at a slight angle. If the proof press (or ink plate) has not been inked, place a small amount of ink on the plate. Distribute the ink evenly over the ink plate with the brayer. When the ink has been distributed, ink the type form by rolling the brayer over the form with very light pressure.
3. When inking the type form, make sure the feet of the brayer are in the up position so they will not damage the type. Replace the brayer on the ink plate so that it rests on the feet. This prevents the brayer from sticking to the plate and becoming flat.
4. After the form has been inked, carefully place one sheet of paper on the form. Roll the cylinder over the form once to transfer the ink from the type to the paper. Carefully lift the paper from the type, and inspect the proof for errors. Look for such things as typographical errors, damaged type, and spacing errors. Before leaving the proof press, clean the type with a rag and solvent to remove all the ink.
5. Assuming there are mistakes, place the galley and the type form on the slanted surface of the type bank, and remove the string. As you read your proof, proceed to correct any mistakes that appear in the type form. Pull another proof when all the mistakes have been corrected.
6. If there are no mistakes on the proof, you may either begin to lock the form in a chase with furniture, or store it in the galley for future use. When placing the galley with type on it in the galley rack, leave the open edge exposed. If there is no type on the galley, place it in the rack upside down and with the open end toward the inside. (**Note:** The **chase** is a rectangular metal frame in which type and plates are locked up for letterpress printing. **Furniture** refers to wood or metal blocks used to fill in around type and other matter when it is locked in a chase.) (Trans. G4-9)

III. **Linoleum block printing**

A. Carving a linoleum block (Trans. G4-10)

1. Basically, two methods of reproducing a linoleum block design are used. In one method, the design is cut in relief on the block. When it is printed, the paper stock provides the background for the design. With the other method, the design is cut into the block, which leaves the background in relief. When printed, the design is actually the color of the stock, and the block print becomes the background of the design.
2. The finished drawing for the linoleum block should be prepared on transparent paper, such as tracing paper, since it must be transferred to the block surface. Since the block will print directly onto the paper, the design must be carved in reverse. Therefore, the design must be placed on the block, face down.

   If the finished drawing has been prepared on tracing paper, it is possible to transfer the design to the block by tracing it through carbon paper. Place the carbon paper, with the carbon side down, on top of the block. Place the drawing face down on top of the carbon paper, and tape the carbon paper and the drawing to the block. The design can now be transferred to the block by tracing with a pencil or pen.
3. To start carving the linoleum block, place it on a bench hook. Outline the design by carving a very thin line with a V-shaped veining tool. Always remember to keep your hands behind the cutting blade. Also, use extreme care when cutting the block. It is not practical to fill in any area of the block if the blade slips.
4. The block should be carved in a manner that will provide a bevel

from the printing surface to the base of the linoleum.

5. After the design has been outlined, the large, nonprinting areas may be removed with a gouge or a flat knife. When using these tools, remember to push away from the design, away from your hands, and to use a bench hook.

B. Follow the same procedure for proofing the block as used for proofing a type form. If any mistakes appear on the proof copy, these may be corrected by careful carving. **(Note to the teacher:** Careful attention should be given to the safe use of the carving knives and tools.)

IV. Rubber stamps

A. In order to construct a rubber stamp, it is necessary to perform the following 10 steps in sequence. These steps are given in outline form, and each should be followed exactly as stated, in order, to get successful results.

Simplified steps for constructing rubber stamps:

1. Set type (heavy Gothic).
2. Proof form.
3. Frame with brass bearers.
4. Lock up form.
5. Preheat stamp press.
6. Cut plastic matrix.
7. Impress matrix.
8. Cut stamp gum.
9. Mold stamp gum.
10. Mount on molding cushion.

B. When generating a design for rubber stamps, use a bold, sans serif design to gain maximum legibility and success in molding the matrix. Gothic bold or medium type both fit this requirement.

C. Proof your type form after composing it and prior to the lockup process. Have another individual proofread the copy, and then make the necessary corrections. Reproof the form to check the corrections you have made. If everything is in order, clean the type.

D. Place the type-high, 12-point brass or steel bearers on the top and bottom of the type form. Now you're ready to lock up the complete form in the special rubber stamp machine chase.

E. Using either the furniture-to-furniture method or the chaser method, lock up the form using metal furniture. Do not use wood furniture or reglets because the heat generated during processing will cause shrinkage and pi the type form when removing it from the machine.

F. Cut a piece of bakelite matrix material that covers the type lines and bearers. This material is a special thermosetting plastic that softens during the first minute or so during the molding cycle. With further heat and pressure, it hardens and becomes a permanent mold or matrix of the type form in the right reading position (Trans. G4-11A, B, C).

G. Preheat the rubber stamp press to a temperature of approximately 300°F. In back of the machine, two light indicators will flash when the heating platens are at the right temperature.

H. When loading the chase with the locked up form into the machine, it is necessary to use shim stock sheets to gain the correct pressure. Use the .050 shim first, placing the chase on top with the type in the face-up position. Place the matrix material on top of the type form. Then use two .010 shim stock sheets to complete the sandwich for correct pressure.

I. Now you are ready to make the impression in the matrix material. Let the form preheat, allowing the matrix material to soften. Then apply steady, even pressure on the handles until they lock into position. When they are locked into position, set the timer for 10 minutes. During this period, the thermosetting plastic matrix material has formed, and further heat will not affect the molded image.

J. Remove the chase from the rubber stamp press when 10 minutes have elapsed. Use heavy gloves to avoid burning yourself. With a screwdriver, pry the matrix from the type, and check it for imperfections. If no imperfections exist, you are ready for the vulcanizing process.

K. Cut a piece of rubber stamp gum a little larger than the outer dimensions of the type lines. Dip the matrix and stamp gum in soapstone. Make sure that any excess is removed, especially

in the areas affecting the image. The soapstone assures the release of the stamp from the matrix after vulcanization.

L. The matrix and rubber are placed on a compensating block which takes up the space previously occupied by the type form. Load the press with the .050 shim stock sheet on the lower platen. Place the compensating block containing the matrix rubber with the holland cloth side up and the two .010 shim stock sheets on top.

M. Using steady, even pressure on the handles, slowly press them into the down position. When the handles have locked into position, set the timer for 10 minutes to completely vulcanize the rubber. Release the handles, and remove the compensating block with the matrix and rubber after 10 minutes have elapsed.

N. Separate the rubber from the matrix, checking for imperfections on the image area of the rubber. If imperfections exist, go through the vulcanizing process. Remember that many stamps can be obtained from the same matrix.

O. To assemble the stamp, you must trim the excess rubber away from the image area and mount it on a cushion molding, using rubber cement. Cut the cushion to length, and insert a black enameled knob when required.

P. Using any color ink pad, proof the completed stamp, and check it for imperfections.

Q. **Note to the teacher:** Careful attention should be given to the heating elements and the heat produced.

MATERIALS FOR STUDENTS

- Foundry type
- California Job Case
- Composing stick
- Printer's rule
- Proof press
- V-shaped veining tool
- Linoleum block
- Tracing paper
- Pencil or pen
- Gouge
- Bench hook
- Flat knife

SUGGESTED STUDENT ACTIVITIES

The student activities in this unit are explained in the sentence outline. They concern letterpress printing, linoleum block printing, and making rubber stamps. Also, have students—

1. identify foundry type.
2. skillfully make use of the California Job Case.
3. use the point and pica measurement system.
4. use the line-spacing and word-spacing materials.
5. use a composing stick in type composition.
6. compose type.
7. proof type.
8. distribute type.

Note: The operation of the letterpress is not included. The teacher should demonstrate and properly direct the students in the operation of the letterpress. Graphic Arts by Darvey Carlsen and other references will be useful.

Vocabulary Worksheet

1. type bank/cabinet

2. imposing table

3. proof press

4. galley

5. brayer

6. lead

7. slug

8. composing stick

9. printer's point system

10. pica

11. point

12. California Job Case

13. demon characters

14. spaces

15. quads

16. proofing

17. linoleum block

18. font

19. line gauge

20. mitering machine

TEST

Unit 4: Relief Printing

Directions: Read each statement carefully. Select the one word of phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. The type bank is used to—

A. store the California Job Cases
B. set type on
C. hold the various type styles
D. all of the above

___ 2. The galley is used to—

A. store the California Job Cases
B. set type on
C. store and transport type forms
D all of the above

___ 3. The line gauge is used to—

A. measure lengths of lines
B. set type in
C. hold the type
D. all of the above

___ 4. The pica is equal to—

A. 1/8 inch
B. 1/6 inch
C. 1/4 inch
D. 1/2 inch

___ 5. Picas are equal to—

A. 4 points
B. 8 points
C. 12 points
D. 16 points

___ 6. A font of type is —

A. an assortment of one face of type
B. an assortment of one size and face of type
C. an assortment of one size of type
D. an assortment of type

___ 7. Some demon characters are—

A. d, b, p, q
B. a, d, r
C. l, m, n, o
D. q, s, t, u

___ 8. Quads are—

A. demon characters
B. spaces
C. fonts
D. 6 picas

___ 9. If a California Job Case is dropped or spilled, it is referred to as—

A. quad type
B. uncomposed type
C. pied type
D. font type

___ 10. Type is transferred from the California Job Case to the—

A. galley
B. type bank
C. composing stick
D. proof press

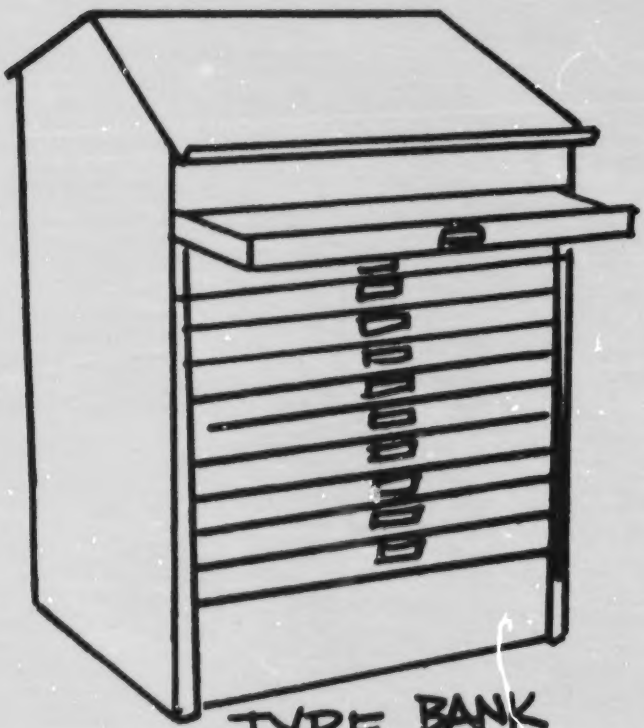
___ 11. The proof press is used to check for—

A. misspelled words
B. upside-down letters
C. incorrect spacing
D. all of the above

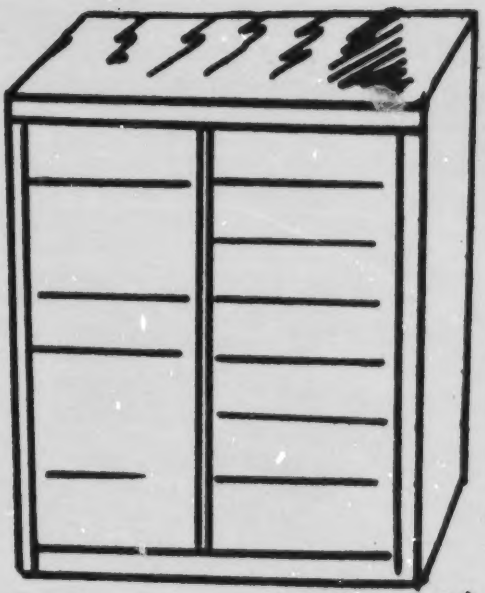
___ 12. The two methods of reproducing the linoleum block design are—

A. the image is offset or the background is offset
B. the image is oblique or the background is oblique
C. the image is etched or the background is etched
D. the image is in relief or the background is in relief

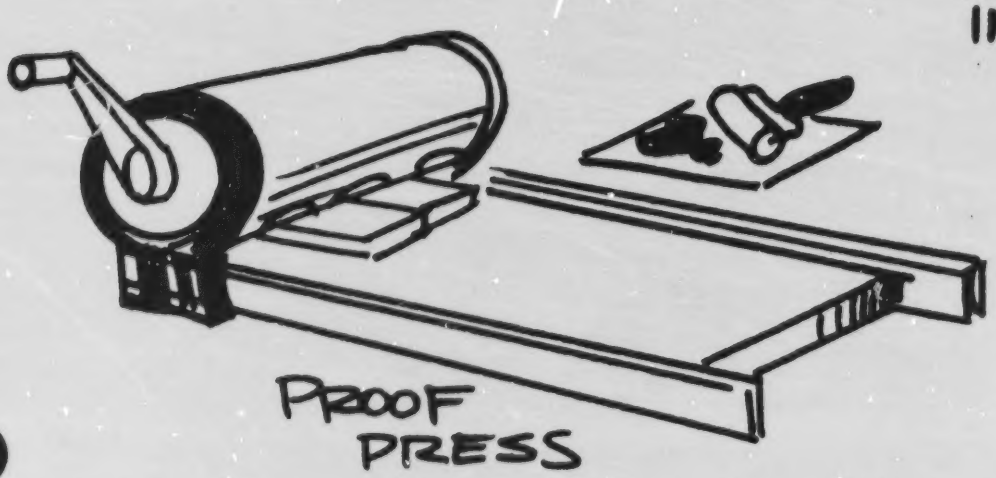
RELIEF PRINTING EQUIPMENT



TYPE BANK

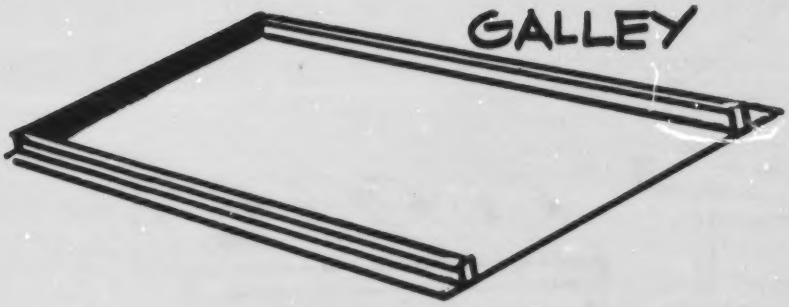


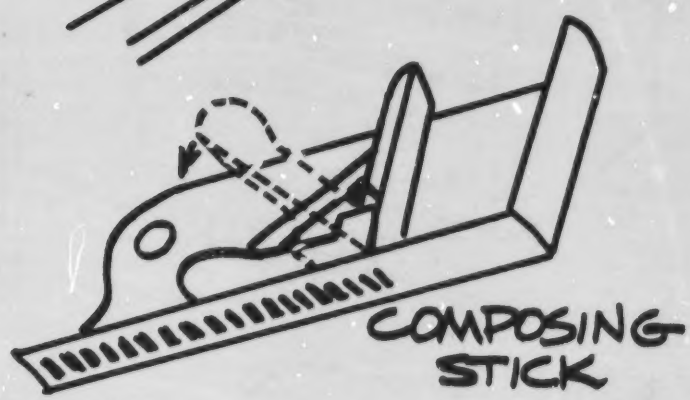
IMPOSING TABLE

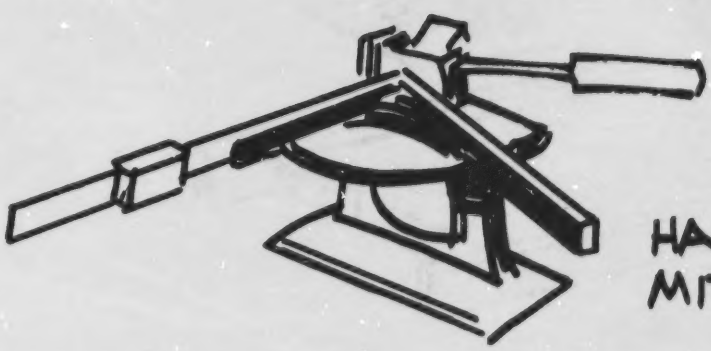


PROOF PRESS

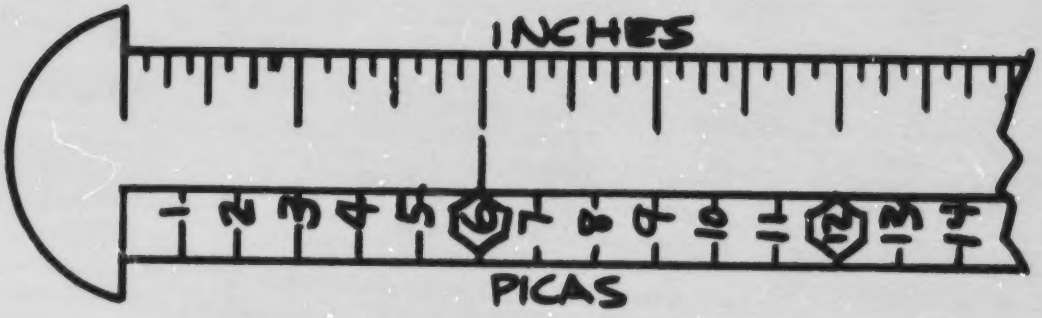
RELIEF PRINTING EQUIPMENT



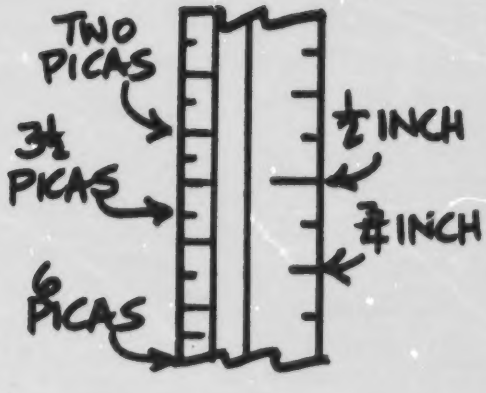




THE PRINTER'S POINT SYSTEM

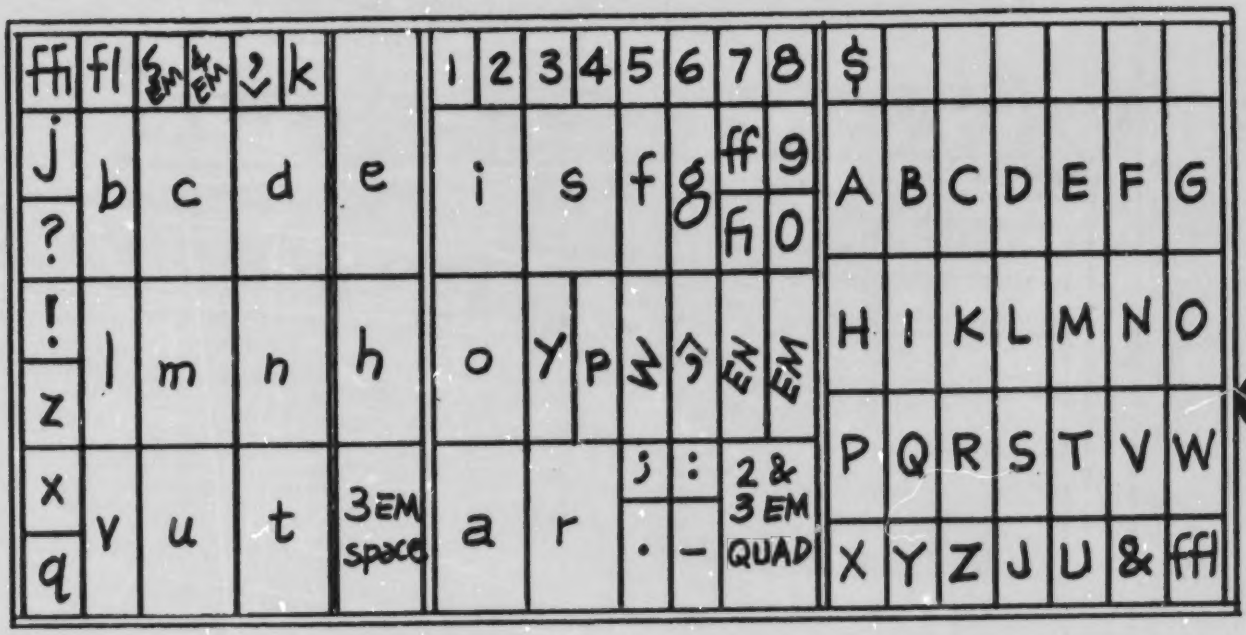


THE LINE GAUGE
(ENLARGED)

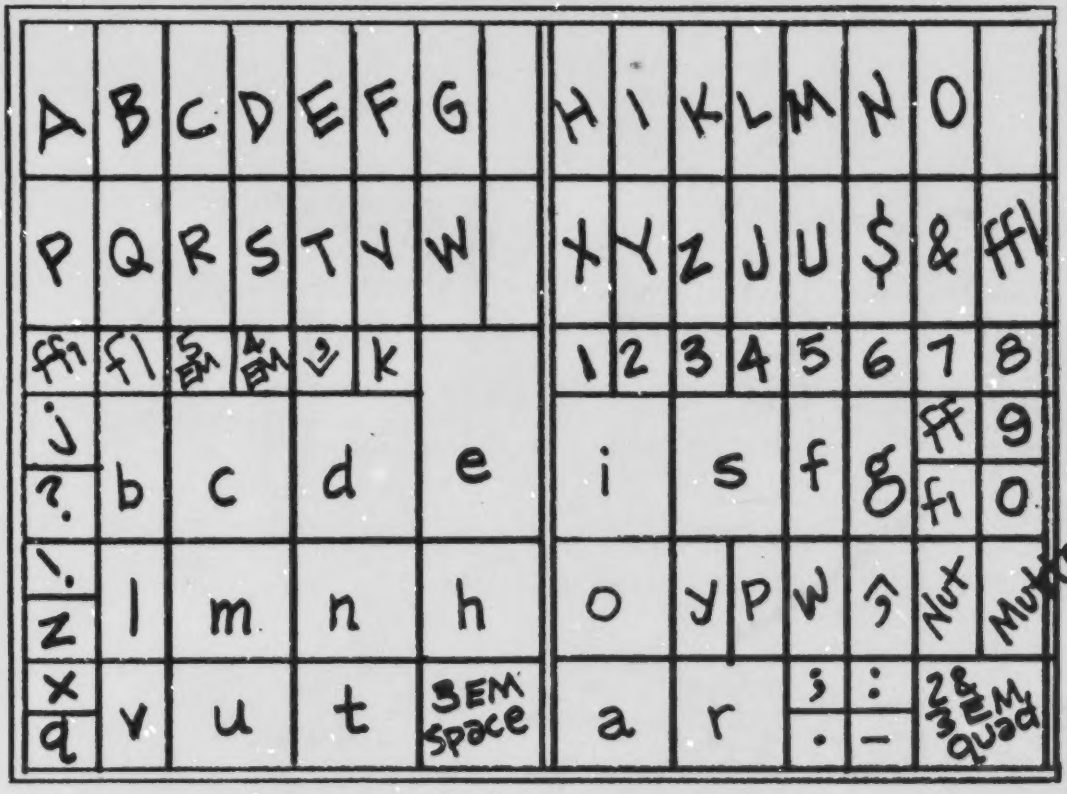


6 POINTS = 1 NONPAREIL
12 POINTS = 1 PICA
6 PICAS = 1 INCH
72 POINTS = 1 INCH
72 PICAS = 1 FOOT

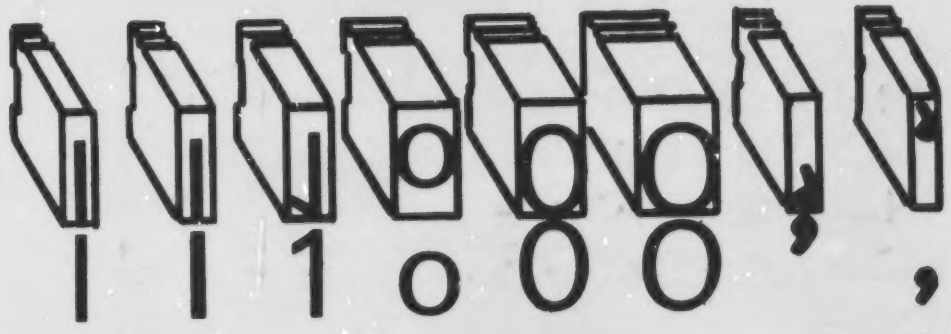
THE CALIFORNIA JOB CASE


ffi fl ¾EM ¼EM ?/ k
j ? b c d e
! z l m n h
x q v u t 3EM space
1 2 3 4 5 6 7 8
i s f g ff 9 fi 0
o Y P W ĵ EN EM
; : 2 & 3 EM
a r . – QUAD
$
A B C D E F G
H I K L M N O
P Q R S T V W
X Y Z J U & ffl

3/3 C.J.C.


A B C D E F G H I K L M N O
P Q R S T V W X Y Z J U $ & ff
ffi fl 5EM 4EM J k 1 2 3 4 5 6 7 8
j b c d e i s f g ff 9
? fi 0
/ z l m n h o y p w ; Nut Muxton
x q v u t SEM space a r . — 2 3 EM quad

THE DEMON CHARACTERS



63

G4-5

SPACES AND QUADS

EM QUAD AND ITS SUBDIVISIONS/WORD DIVISIONS

EM QUAD (square of point size),
Mutton

EN QUAD ($\frac{1}{2}$ of an EM),
Nut

3-to-the-EM ($\frac{1}{3}$ of an EM),
3EM Space (word space)

4-to-the EM ($\frac{1}{4}$ of an EM),
4EM Space

5-to-the EM ($\frac{1}{5}$ of an EM),
5EM Space

6-to an EM ($\frac{1}{6}$ of an EM),
6EM Space

VARIOUS LEADS FOR CREATING SPACE BETWEEN LINES OF TYPE

1 POINT

2 POINT

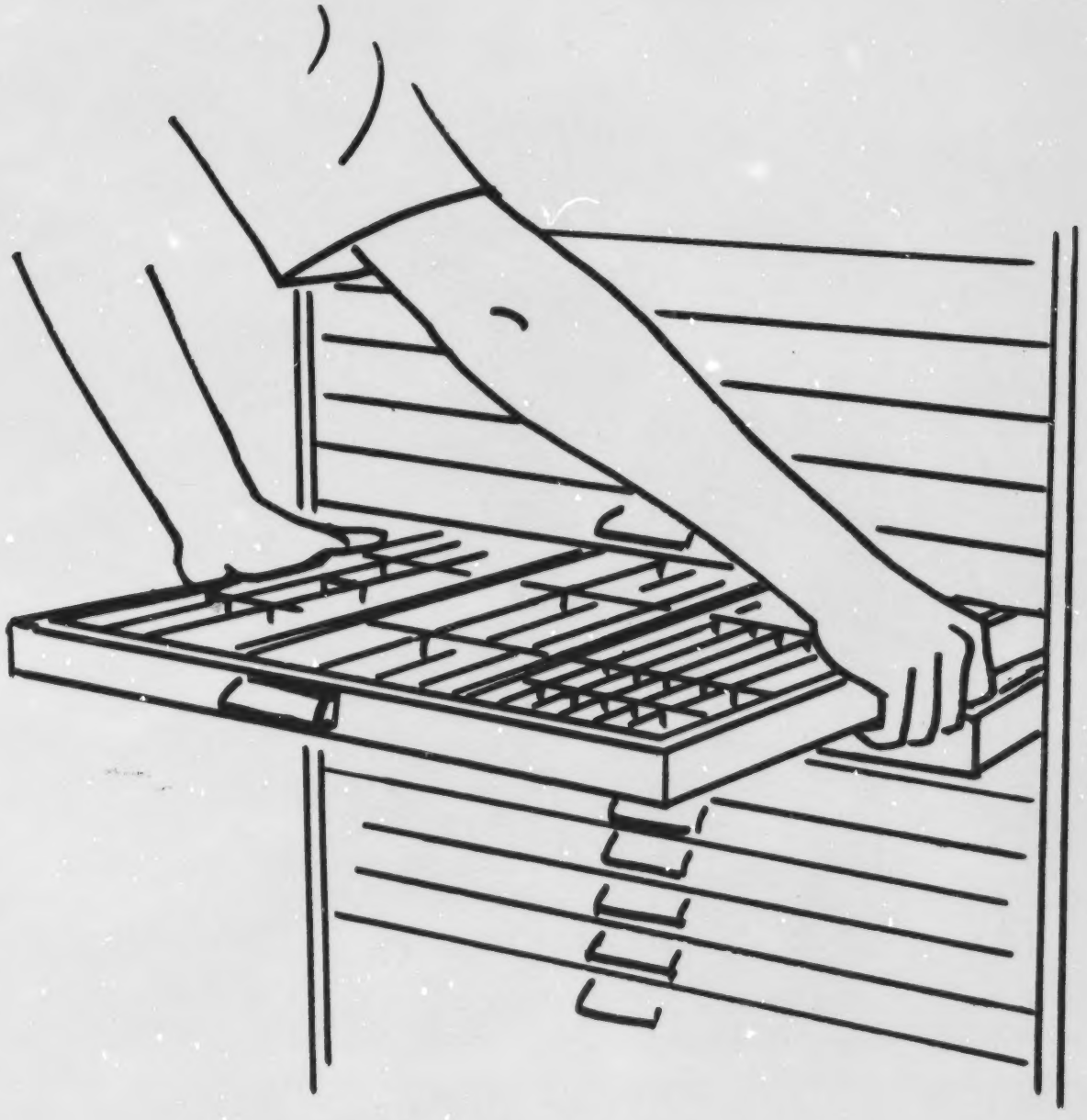
3 POINT

4 POINT

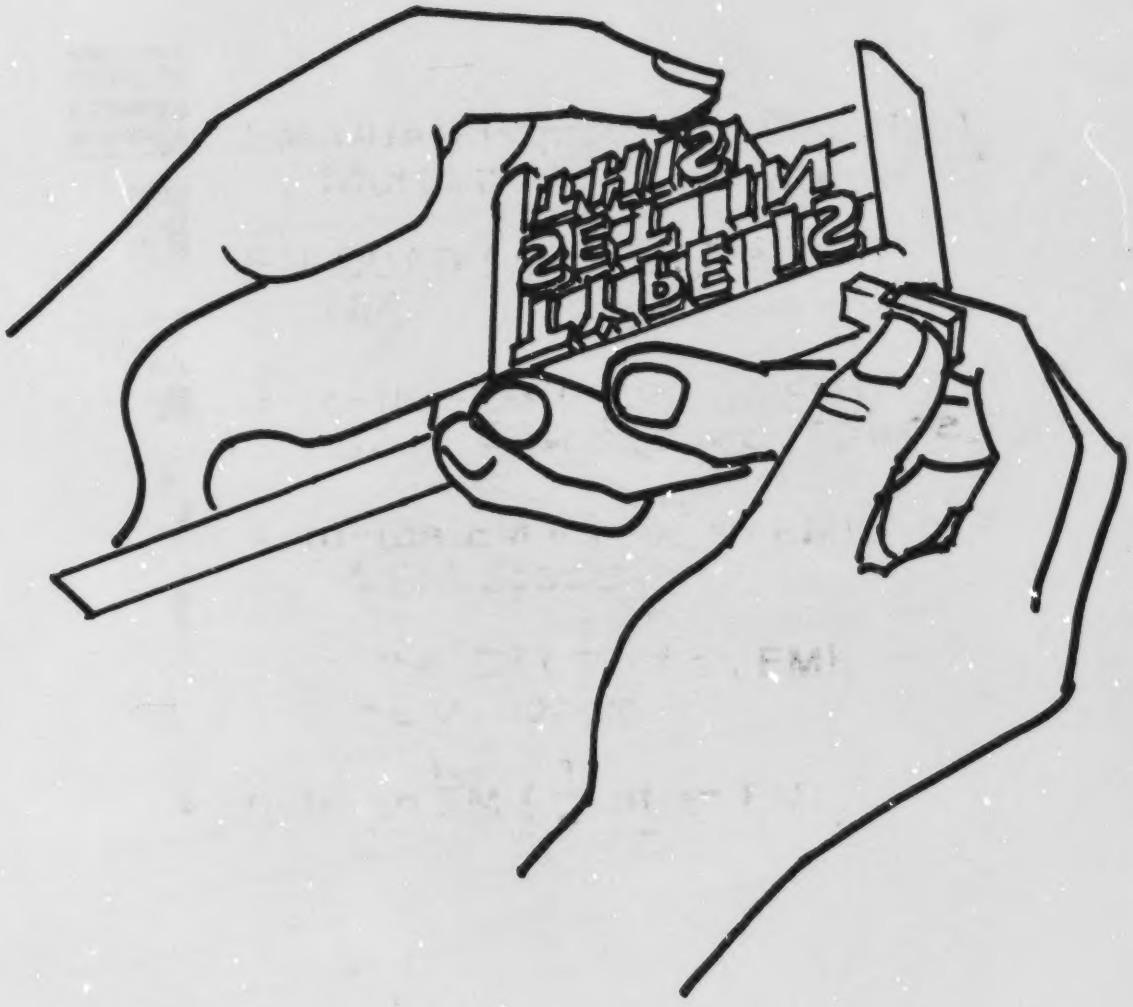
6 POINT

G4-6B

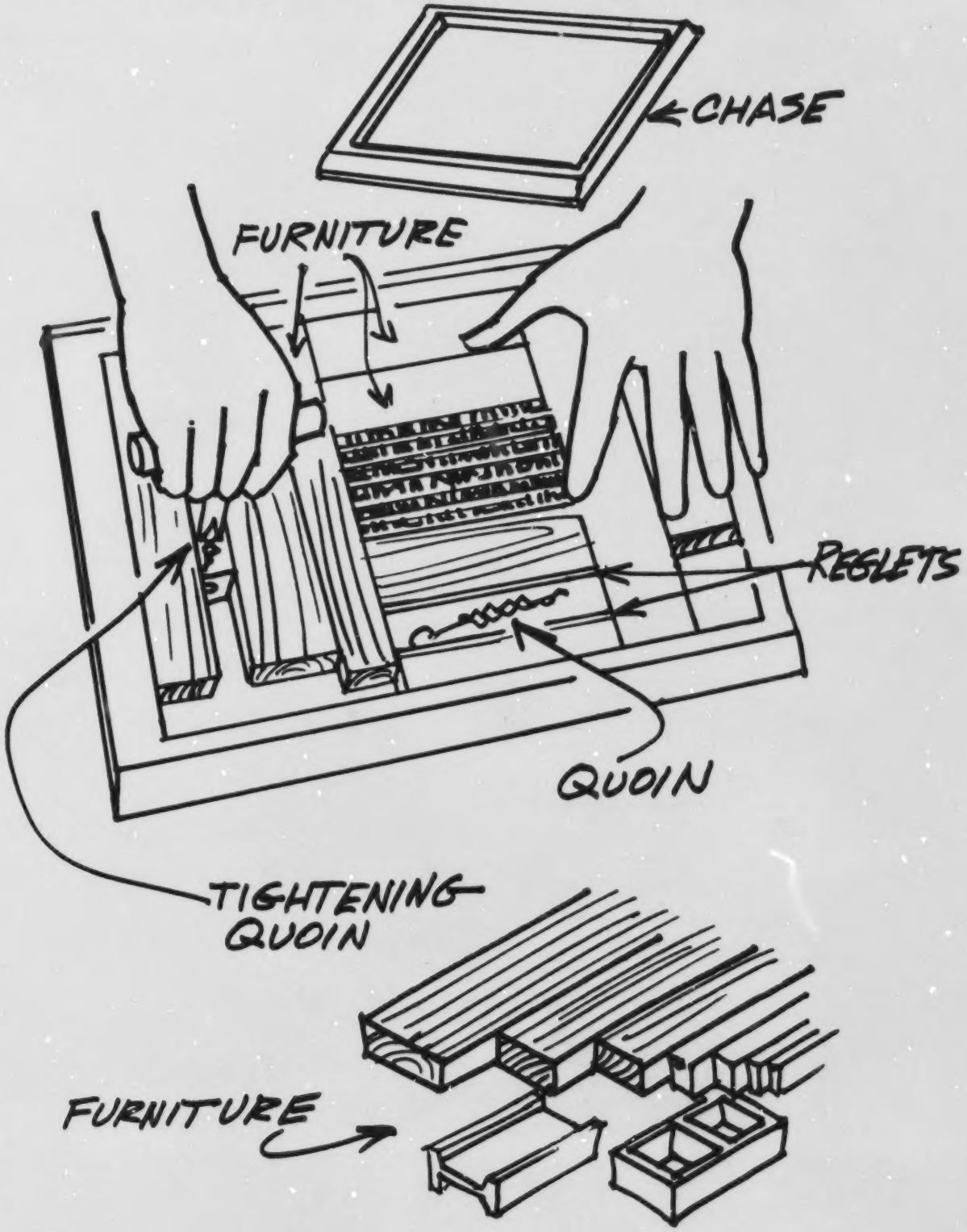
REMOVING THE CASE FROM THE TYPE BANK.



THE LEFT THUMB HOLDS THE TYPE IN PLACE.

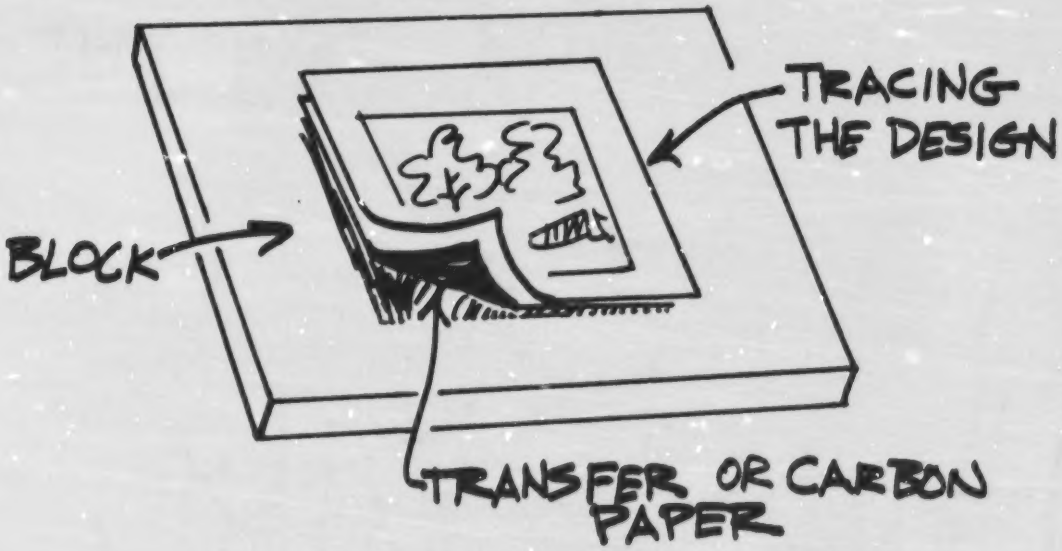


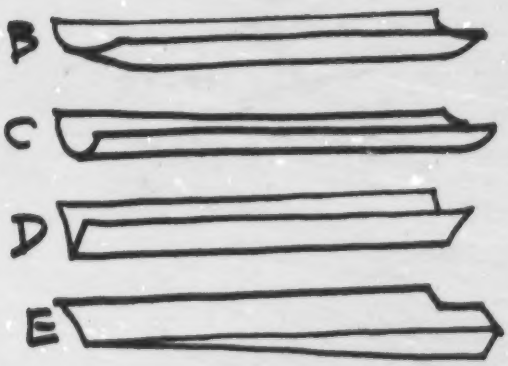
CHASE AND FURNITURE



G4-9

TRANSFERRING THE DESIGN TO BLOCK

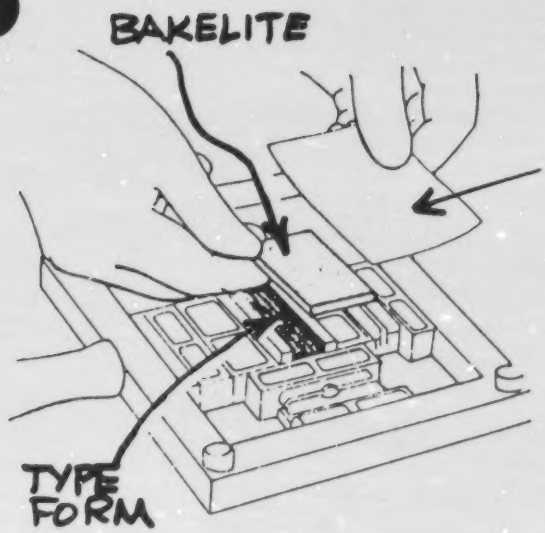




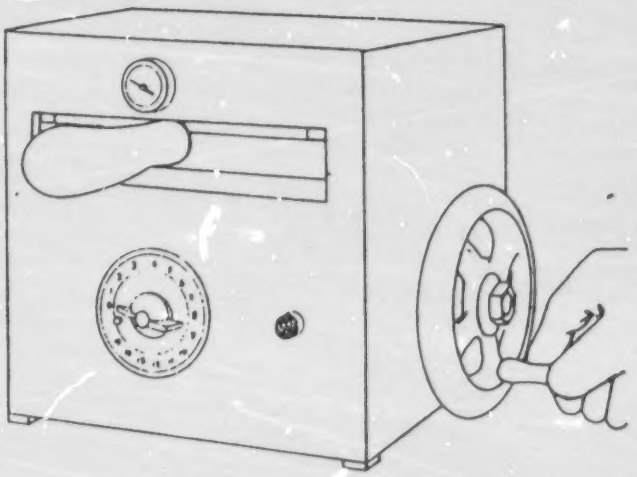
A-GOUGE WITH HANDLE
B-"C"-SHAPE GOUGE
C-"U"-SHAPE GOUGE
D-"V"-SHAPE GOUGE
E-CHISEL
F-CUTTING KNIFE

TOOLS USED FOR CUTTING WOOD AND LINOLEUM BLOCKS

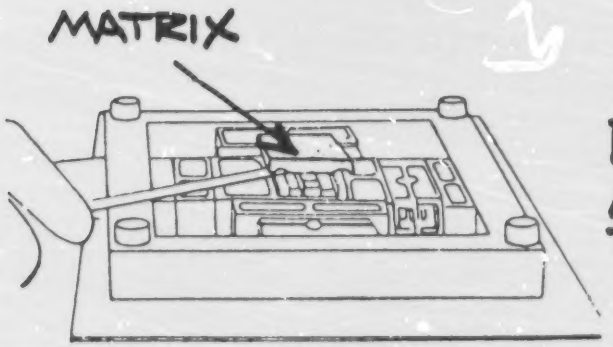
MAKING A RUBBER STAMP



PLACE THE BAKELITE ON TOP OF THE TYPE FORM, AND COVER IT WITH A PIECE OF PAPER.

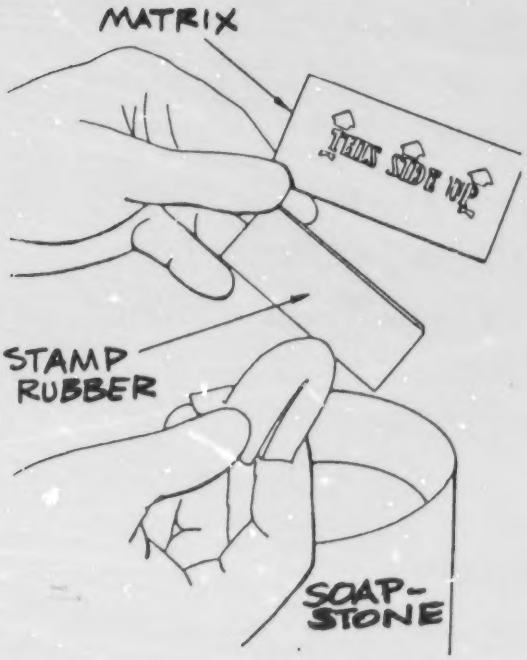


TURN THE HAND WHEEL UNTIL THE FIRST RESISTANCE IS FELT.

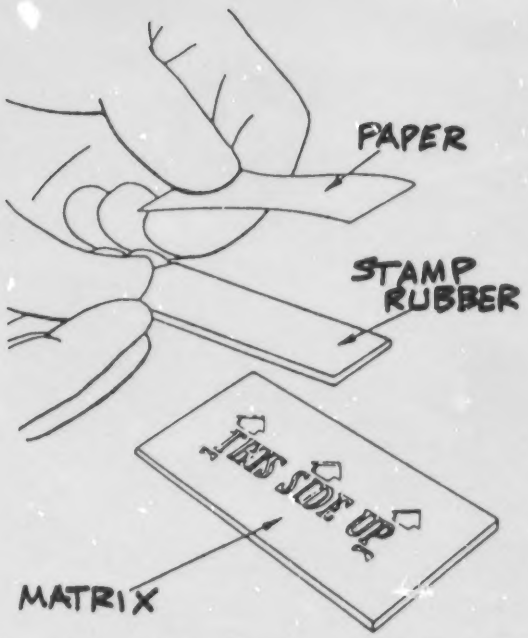


PRY THE FORM MATRIX FROM THE TYPE.

MAKING A RUBBER STAMP



DUST THE RUBBER AND THE MATRIX WITH SOAPSTONE.



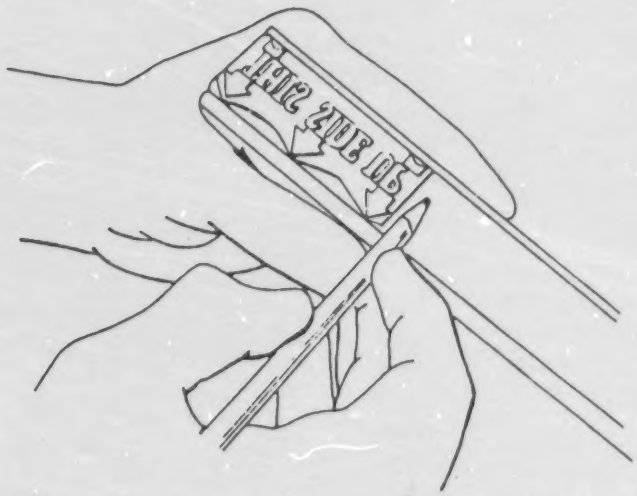
PLACE THE STAMP RUBBER ON TOP OF THE MATRIX AND COVER IT WITH A PIECE OF PAPER.

STRIP THE STAMP RUBBER FROM THE MATRIX.

71

MAKING A RUBBER STAMP

TRIM OFF THE EXCESS RUBBER.



MARK AND CUT THE HANDLES TO LENGTH.

5 Gravure Printing

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the gravure printing process;
2. demonstrate the gravure printing process through drypoint etching; and
3. identify the application of gravure printing in today's printed material.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

gravure printing
intaglio printing
rotogravure
drypoint etching
engraving

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-B, 2-A, 3-B, 4-B, 5-C, 6-A, 7-D, 8-D, 9-A, 10-C.
- Examples of gravure printing
- Transparencies: You will find transparencies G5-1 through G5-4 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G5-1: The Operating Principle in a Gravure Press
  G5-2: Examples of Gravure Printing
  G5-3: Rotogravure Process
  G5-4: Drypoint Etching

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Adams, J. Michael, and Faux, David D. Printing Technology. 2nd ed. Belmont, Calif.: Wadsworth Publishers, 1982.

Broekhuizen, Richard J. Graphic Communications. Bloomington, Ill.: McKnight Publishing, 1979.

Dennis, Ervin A., and Jenkins, John D. Comprehensive Graphic Arts. Indianapolis, Ind.: Bobbs-Merrill Educational Publishing, 1983.

Spence, William P., and Vequist, David G. Graphic Reproduction. Peoria, Ill.: Charles A. Bennett Company, 1980.

SENTENCE OUTLINE

I. **Gravure printing process**
   A. Gravure printing, the opposite of relief printing, is defined as printing from below the surface. The printing image area is engraved or cut into the surface of the printing plate. The ink from the gravure plate is transferred to the paper by capillary action when the plate and the paper are pressed together (Transparency G5-1).
   B. Gravure printing, or **intaglio printing** as it is sometimes called, is one of the most versatile and flexible of the major printing methods. Commercial gravure printing plates, generally made of copper, are first coated with an acid resist. The design is then scratched through the resist to expose the bare metal. The plate is then placed in an acid bath which etches the design into the metal (Trans. G5-2).
   C. The major uses of the gravure printing process are in newspapers, magazines, food packaging, wood grain effects, floor coverings, postage stamps, and currency (paper money).
   D. In the printing process, ink is spread over the metal surface. Excess ink is removed with a blade called the doctor blade. The metal surface is free of ink, while the thousands of depressions are full of ink. Each little hole acts as an inkwell. When the paper is pressed against the metal surface, the ink transfers to it much the same as a blotter picks up ink. The ink dots printed on the paper surface form the image. It would take about 10 such inkwells to print the period at the end of this sentence.
   E. Gravure can be printed from flat plates or from a cylinder. If a

cylinder is used, it is called **rotogravure** (Trans. G5-3).

II. **Drypoint etching**

A. To simulate the gravure printing process, a drypoint etching can be made by using a piece of polished vinylite or plastic. The design is **engraved** into the surface of the plastic with any sharp pointed instrument such as a pin, a phonograph needle, or the corner of a razor blade (Trans. G5-4).

B. The design for a drypoint etching should lend itself to line reproduction. The design should be composed of a series of definite lines rather than having solid tonal area.

C. The original design should be prepared on paper. It is then attached to a piece of plastic that is about one inch larger than the design on all sides.

D. If the reproduction is to have dark areas, the lines must be engraved close together. In the lighter areas of the reproduction, the lines may be engraved apart from each other. It is also possible to regulate the lightness and darkness of the print by the depth of the engraved lines.

Generally, the deeper the incised or engraved lines, the darker the print. Crosshatched lines can be used to reproduce shaded areas or areas that require an almost solid tone. The progress of the drypoint etching can be checked by sliding a piece of colored paper between the design and the plastic. This enables you to see the engraved lines in the plastic better.

E. To ink the drypoint etching, a mixture of printer's ink and oil is used. Place a small quantity of ink on a piece of glass or on the back of a galley, and add a few drops of oil. The oil should reduce the consistency of the ink to about one-third. The ink and oil are mixed together with the index finger.

F. To ink the drypoint etching, rub the ink and oil mixture into the incised lines with your finger. Rub the ink over the entire surface of the drypoint, making sure the ink gets into every depression.

G. The excess ink must now be removed from the surface of the etching. Using a folded piece of paper towel, begin to wipe off the surface ink. It is best to work at right angles to the engraved lines, if possible. This reduces the amount of ink that is removed from the engraved lines. The final wiping should be done with the heel of the hand.

H. Use the block printing proof press (if available) for printing the drypoint etching. Build up the proof press by placing several newspapers on the bed. The drypoint is then placed on top of the newspaper, face up. To achieve best results, the design must first be offset to a rubber blanket before being printed on the paper.

Carefully place a rubber blanket, face down, on top of the drypoint etching. The impression can now be transferred to the blanket by rolling the cylinder over the blanket. If the cylinder resists rolling, there is too much packing and some of the newspaper must be removed. If there is no resistance, or the cylinder only slightly contacts the back of the blanket, there is not enough packing. More newspaper must be added under the drypoint etching.

I. After the impression has been made, carefully remove the blanket from the drypoint etching. To transfer the image from the blanket to the paper, place a sheet of paper on top of the newspaper. Carefully lay the rubber blanket, face down, on top of the paper to be printed. Roll the cylinder over the blanket to transfer the design to the paper.

J. Separate the blanket and the printed sheet. If the nonprinting areas of the etching produce an unwanted cast, it indicates that the etching was not properly wiped. This is generally caused by using ink that is too thick. If the image is too light, the ink used for the etching is too thin. Use this print as a proof. Before making more prints, inspect the proof and make any necessary corrections.

K. The drypoint etching, rubber blanket, and the galley or the glass can be cleaned with a rag and solvent.

MATERIALS FOR STUDENTS

- Plastic (X-ray film or ortho film works well)
- Sharp, pointed instrument (needle, sharpened nail, dental tools)
- Printer's ink
- Oil, lubricant
- Paper towels
- Block printing press, if available
- Rubber blanket
- Newspaper
- Paper
- Rag, solvent

SUGGESTED STUDENT ACTIVITIES

1. List examples of drypoint etching in printed materials.
2. Have students identify characteristics of drypoint etching in printed materials.
3. List examples of engraving in printed materials.
4. Have students select or draw and design a picture to use in drypoint etching. Follow the steps as indicated in the sentence outline.

Vocabulary Worksheet

1. gravure printing

2. intaglio printing

3. drypoint etching

4. engraving

5. rotogravure

TEST

Unit 5: Gravure Printing

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Gravure printing is the opposite of—

A. intaglio printing
B. relief printing
C. offset printing
D. planographic printing

___ 2. Gravure printing is sometimes called—

A. intaglio printing
B. relief printing
C. offset printing
D. planographic printing

___ 3. Gravure printing is defined as printing from—

A. above the printing surface
B. below the printing surface
C. the printing surface
D. all of the above

___ 4. An example of gravure printing is—

A. letterpress
B. drypoint etching
C. rubber stamps
D. all of the above

___ 5. Some uses of the gravure printing process are for—

A. rubber stamps, business cards
B. T-shirts, printed cloth
C. food packaging, postage stamps
D. thermography, planography

77

___ 6. In the printing process, ink spread over the metal surface is then removed by—

A. the doctor blade
B. the roto blade
C. the grave blade
D. the ink blade

___ 7. The image on a gravure print is made up of—

A. lines
B. blots
C. powder
D. dots

___ 8. It would take about _____ inkwells in gravure printing to print the period at the end of this sentence.

A. one
B. four
C. eight
D. ten

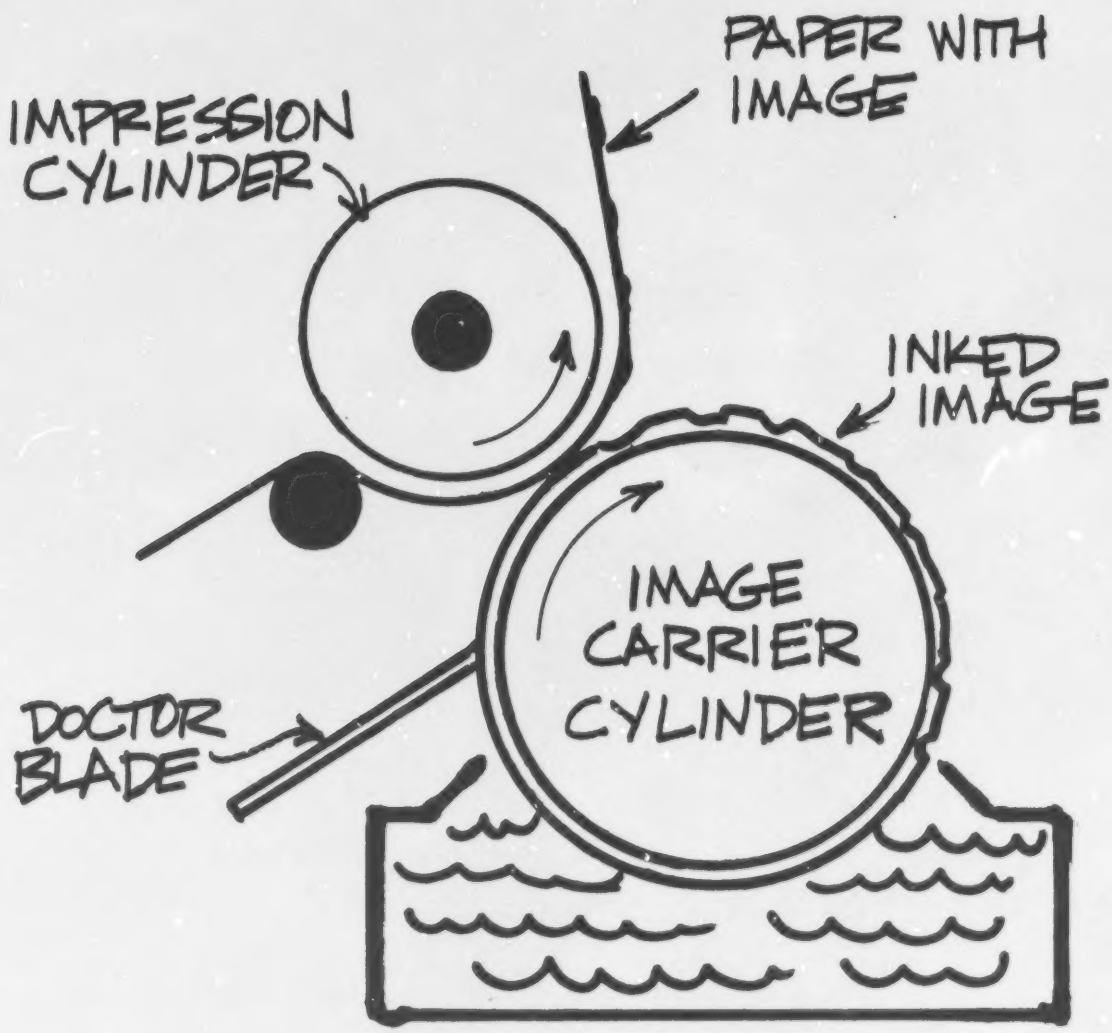
___ 9. Gravure can be printed from—

A. flat plates or a cylinder
B. angle plates
C. raised plates
D. all of the above

___ 10. If a cylinder is used for gravure printing, it is called—

A. cylinder gravure
B. curved gravure
C. rotogravure
D. round gravure

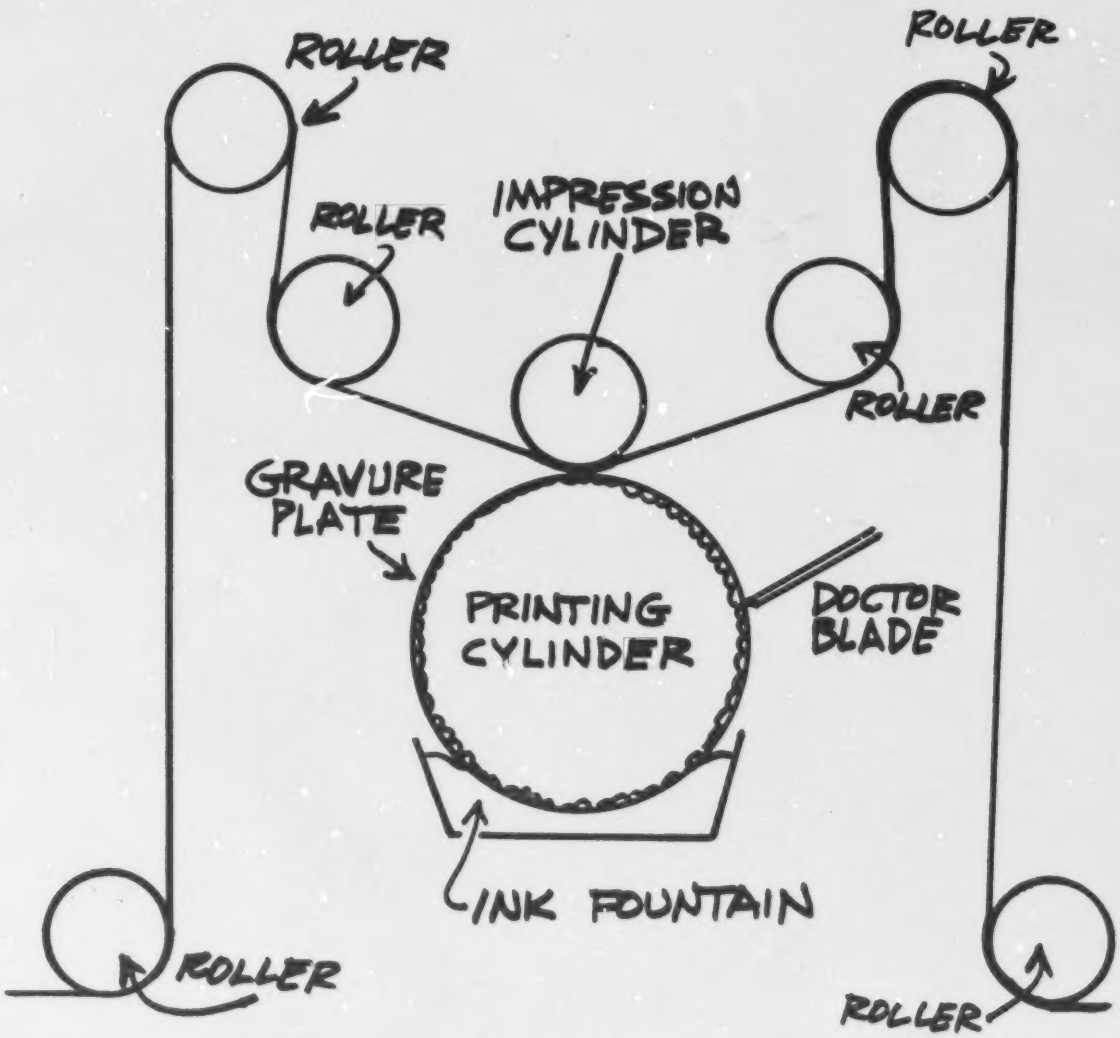
THE OPERATING PRINCIPLE IN A GRAVURE PRESS



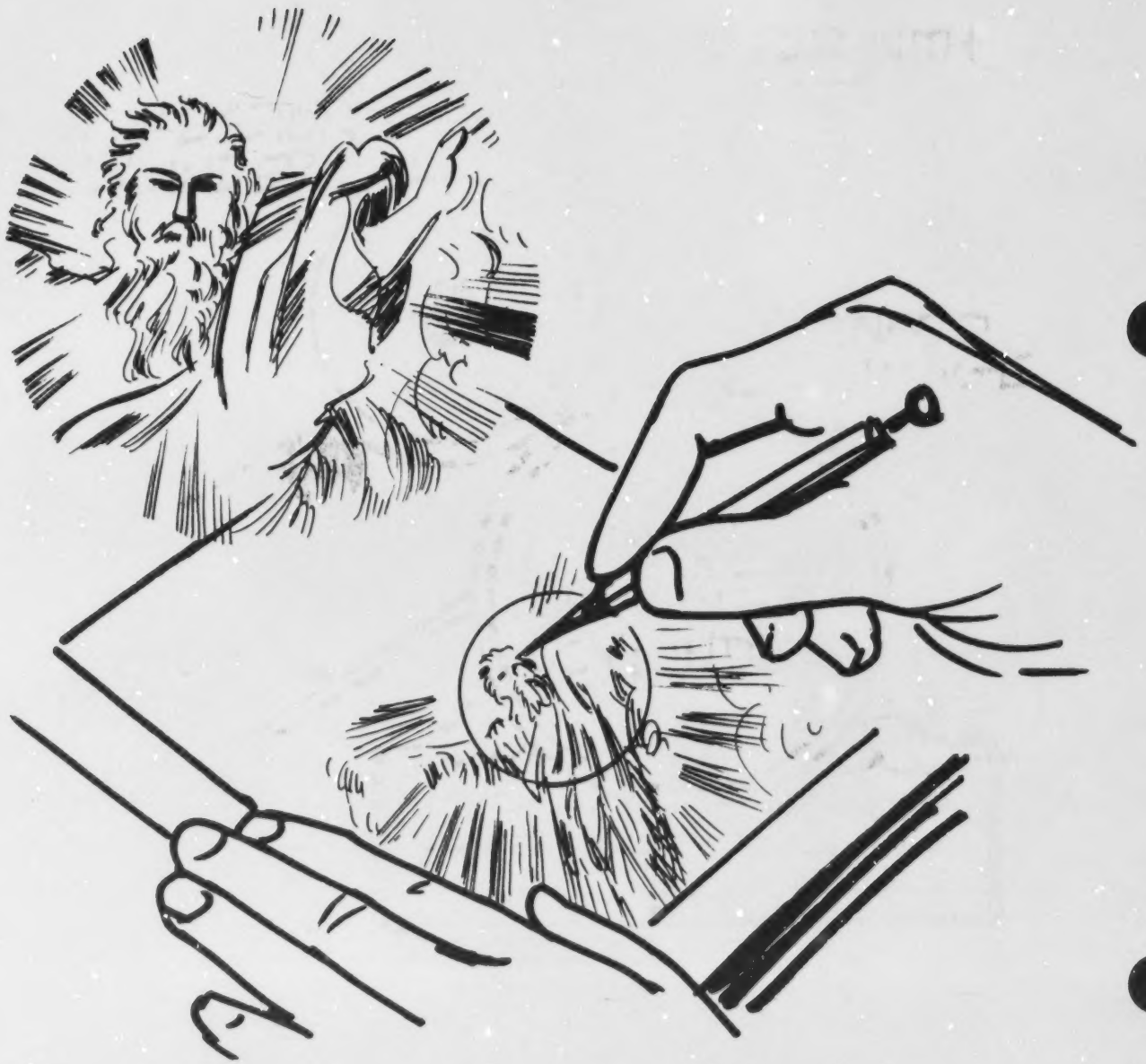
EXAMPLES OF GRAVURE PRINTING

- CATALOGS
- RECORD ALBUMS
- FOOD PACKAGE LABELS
- FLOOR COVERINGS
- MAGAZINES
- TABLE COUNTER LAMINATES

ROTOGRAVURE PROCESS



DRY POINT ETCHING



6 Screen Process Printing

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the process of silk-screen printing; and
2. demonstrate competencies by completing the steps in making silk-screen prints.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

dry rack	ink spatula
screen frame	squeegee
side kick	silk
tite-stretch tool	stencil
base	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-D, 2-A, 3-A, 4-A, 5-D, 6-B, 7-D, 8-D, 9-A, 10-D
- Transparencies: You will find transparencies G6-1 through G6-4 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G6-1: Silk-Screen Printing Equipment
  G6-2: Stretching the Screen
  G6-3: Cutting the Stencil Film
  G6-4: Printing the Stencil

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Angerame, Michael. Silk-Screen Learning Kit. New York: McGraw-Hill Book Company, 1981.

Biegeleisen, J. I. The Complete Book of Silk-Screen Printing Production. New York: Dover Publications, 1963.

Dennis, Ervin A., and Jenkins, John D. Comprehensive Graphic Arts. Indianapolis, Ind.: Bobbs-Merrill Educational Publishing, 1983.

SENTENCE OUTLINE

I. Equipment
  A. Introduction
    During the last decade, elaborate and complex screen printing units have been developed. However, excellent results can be obtained by using the simplest, most basic equipment.
  B. Types of equipment
    1. Generally, silk-screen prints have a large area of printed surface. Because of this, it is impossible to place one print on top of another until each is dry. The **dry rack** is designed to store prints until they are dry. Because of its many shelves, it is possible to store the prints in a confined area and not stack them on top of one another. The design of the dry rack makes it necessary to start at the bottom. As each shelf fills up, the next one can be lowered into position.
    2. The **screen frame** supports or holds the silk in a tightly stretched position. The silk can be attached to the frame by either the staple method or the cord method (Transparency G6-1).
    3. The **side kick** is attached to the screen frame. As you can see, the side kick holds the screen frame away from the base for easy removal and positioning of paper against the register guides. To close the printing unit, light pressure is applied in a downward direction. The side kick folds and allows the frame to be placed in the printing position.
    4. In the cord method of stretching silk on a frame, it is necessary to force the silk into a groove around the frame.

       To do this, a cord is placed over the silk and is then driven into the groove. The **tite-stretch tool** is used for this purpose. The tool is placed on top of the cord and then gently tapped with a mallet. This

forces the cord into the groove and tightens the silk.

5. When the printing unit is assembled, the screen frame is hinged at one end to the printing **base,** a smooth, flat surface. This is where the paper guides are positioned and the paper to be printed is placed.
6. The **ink spatula** is used to remove the ink from the container and place it on the screen. It is also used for removing the excess ink from the screen before cleaning.
7. A **squeegee** is used to force the ink through the stencil and onto the paper. It consists of a hard, rubber blade that is fastened to a handle. The squeegee should be slightly longer than the image area. It is held at a 30^{0} angle when printing and is passed over the stencil only once for each print.

II. Screen material

A. The type of open-weave material used to stretch over the frame depends on the type and quality of printing desired, the type of stencil used, and the surface to be printed on. Common fabrics for screen printing are silk, organdy, cotton, nylon, linen, and stainless steel cloth.

B. For general-purpose printing, the most suitable fabric is **silk.** The opening size in the silk or the mesh may vary from 6XX (course) to 18XX (very fine). Course-mesh silk is used for big designs that require a heavy deposit of ink. Finer-mesh silk is used for small designs with fine detail work. For average work, a medium-mesh silk, 10XX, is recommended.

C. The silk on the printing frame must be perfectly clean and free from clogged areas to ensure quality printing of the design. The silk must also be free of holes and runs because they will appear as imperfections on the printed copy. Following is the procedure for the tite-stretch method of attaching silk (Trans. G6-2):

1. Inspect the frame, and remove any sharp edges that could contact the silk.
2. Cut a piece of silk that is about the same size as the outside dimension of the frame.
3. Obtain four pieces of tite-stretch cord, one for each side of the frame. The cord should be the same length as the grooves.
4. Wash the silk in warm water to remove any starch that may be in the cloth.
5. Lay the silk over the frame, and press the cord over the silk into the groove, using finger pressure.
6. Repeat step 5 on the opposite side of the frame. Pull the silk lightly before pressing the cord into the groove.
7. Press the cord over the silk into the groove on the third side of the frame.
8. Press the cord over the silk into the groove on the fourth side of the frame. Pull the silk lightly before pressing the cord into the groove.
9. Examine the silk to make sure that it is properly positioned on the frame and free of wrinkles.
10. If there are no wrinkles, drive the cord down into the groove with a mallet so that the cord is even with the top of the frame.
11. Use the tite-stretch tool to drive the cord deeper into the groove. In order to stretch the silk evenly, go around the frame several times, driving the cord down only a small amount each time.
12. After the silk has been tightly stretched, trim off any side that hangs over the outside edge of the frame.
13. Apply silk tight to the cord and to the silk that extends over the edge of the frame.
14. After the silk tight has dried, turn the frame over and mask the inside corners with gummed tape.

D. Procedures for the staple method of attaching silk:

1. Inspect the frame and remove any sharp edges that could contact the silk.
2. Cut a piece of silk that is about the same size as the outside dimension of the frame.
3. Wash the silk in warm water to remove any starch that may be in the cloth.

84

4. Lay the silk over the frame. Begin stapling the silk to the frame by placing one staple in the center of one end. The length of the staple should run parallel to the frame length.
5. Pull the silk to the opposite end of the frame, and place one staple in the center of that end.
6. Staple the sides of the silk to the frame by placing one staple in the center of each side. Stretch the silk before putting in the staple.
7. Begin stapling the silk to the frame along the long edge of the frame. Work from the center to the ends of the frame. Be sure to stretch the silk before each staple is inserted.
8. Stretch and staple the silk to the ends of the frame. Work from the center to the corners of the frame. The last staples that are placed in the frame should be at the corners.
9. After the stapling has been completed, trim off any silk that hangs over the outside edge of the frame.
10. Apply silk tight to the silk that extends over the frame.
11. After the silk tight has dried, turn the frame over and mask the inside corners with gummed tape.

III. Paper stencil

A. The paper stencil is one of the simplest of all screen stencils. The stencil is usually made of kraft paper with the printing areas cut out. The stencil is then fastened to the screen, and ink is forced through the open areas by the squeegee.

B. The paper stencil method is commonly used for work involving simple designs, generally of one color. The paper stencil will not withstand repeated use and is not recommended for use when a large number of copies is required. This type of stencil is not recommended for designs or lettering that have loose centers, such as the insides of the letters "o, p, a, and b."

C. Procedure for using paper stencil

1. Prepare your design on bond paper. This design must appear exactly as you want the finished product to appear. Both the size and the position of the paper must correspond exactly to the finished product.
2. Cut a piece of kraft paper that is the same size as the inside dimensions of the screen frame.
3. Trace the original design on the kraft paper approximately in the center.
4. Using a sharp knife, cut out the printing area. Use the light table as the cutting surface.
5. Assemble the screen frame, the printing base, and the side kick.
6. Place the original design approximately in the center of the base.
7. Position two register guides on the long side of the paper and one on the short side toward the hinged end of the frame.
8. Place the prepared stencil in register over the original design.
9. Being careful not to allow the stencil to slip from position, lower the frame.
10. Place several spots of glue on the silk to hold the stencil in position.
11. After the glue has dried, turn the frame over. Using gummed tape, tape all four sides of the paper stencil to the frame. Do not remove the frame from the screen.
12. Remove the original design from the register guides.
13. Using an ink spatula, place a small quantity of ink on the screen. Sufficient ink should be used to cover the design. The ink should roll in front of the squeegee.
14. Position the paper against the register guides. Hold the squeegee at a 30° angle to the design. Using downward pressure, pull the squeegee across the stencil, forcing the ink through the open areas of the stencil. For best results, use a squeegee that is slightly wider than the design area. Only one pass over the stencil is required.
15. After each print, raise the frame and allow it to rest on the side kick. Remove the printed copy,

and insert another sheet against the register guides. Printed copies should be stored in the dry rack. Do not stack them on top of one another or they will stick together.

16. Lower the frame, and repeat the printing operation. It will be necessary to add fresh ink to the screen periodically.
17. Upon completion of printing, begin to clean the screen by first scraping the excess ink from the screen with an ink spatula. Return the ink to the proper container.
18. The gummed tape can now be removed from the inside corners of the screen frame.
19. Remove the stencil from the screen.
20. Place several layers of newspaper on the screen base and lower the frame.
21. Pour solvent on the screen, and begin wiping it with a rag or paper towel. The ink and the solvent will be absorbed by the newspaper. Therefore, it may be necessary to change the newspaper several times.
22. Continue cleaning with the solvent until all traces of ink have been removed from the screen.
23. Clean the squeegee and the ink spatula with solvent and paper towels or rags. Always work over newspapers.

IV. Hand-cut film stencil

Hand-cut film is made of a thin film of gelatinous material on a plastic, wax paper, or mylar backing. Basically, there are two types of hand-cut film for silk-screen printing. These are lacquer film and aqua film. As the name implies, lacquer film is soluble in lacquer thinner, and must be used with a water-base ink. Aqua film, on the other hand, requires the use of a lacquer-base ink since the film is water-soluble.

A. Design

The design for a hand-cut film stencil should be prepared at actual size on paper. The design should be drawn with heavy lines and solid areas. If two or more colors are to be used, it may be helpful to prepare the design with colored pencils to indicate the color separations since each printed color requires an individual stencil. To print a two-color design, it is necessary to cut two stencils. Three colors require three stencils, and so on.

B. Cutting the film stencil (Trans. G6-3)

1. Cut the film about two inches larger than the original design on all sides. Remember, one piece of the film is required for each printed color.
2. When cutting the film stencil, it is necessary to work on a hard, flat surface. The light table surface is best. Securely tape the original design to the surface of the light table in the right reading or face up position. The film is now taped in position over the original design with the gelatinous side up. The gelatinous side is usually the shiny side, and it is easily cut and peeled away.
3. Using a sharp stencil knife, X-acto knife, or razor blade, begin cutting the stencil for the first color. Light pressure on the cutting tool is required since it is only necessary to cut through the gelatinous coating. Do not cut through the backing.
4. After a line or area has been completely cut around, remove the gelatinous coating from the area. This will form the printing area. Wherever the gelatinous coating is removed, a printing area is created. It may be necessary to use the point of the cutting tool to start to peel away the coating. Pull the gelatin from the backing very slowly and carefully, checking it to be sure no part was missed when cutting.
5. When the stencil for the first color has been completely cut, remove the film from the original design. The second color stencil may now be cut by repeating the process. The technique for cutting both the lacquer film and the aqua film is the same.

C. Adhering the film to the screen

1. Before adhering the stencil to the screen, it is necessary to prepare the printing unit.
2. After assembling the printing unit, place the original design on the printing base, and position the registration guides. The stencil for the first color may now be placed in register on top of the original design.
3. Carefully lower the screen frame to the stencil film, making sure that the screen fabric comes in direct contact with the film. If lacquer film was used for the stencil, lacquer thinner must be used to adhere the stencil to the screen fabric. If aqua film was used for the stencil, water is used to adhere the stencil. The procedure for either type of film is the same.
4. Moisten a cotton pad or a stiff nylon brush with the proper adhering liquid. Gently press down on the silk, which is in contact with the stencil. **Do not rub** because this will "burn" the gelatinous material of the stencil. The adhering liquid softens the gelatinous material of the stencil and allows the screen fabric to be pushed into it when the downward pressure is applied.

   The stencil darkens when it has properly adhered. If a stencil shows a lighter color in spots, this indicates poor adhesion. To correct this, simply reapply the adhering liquid with the cotton pad or brush. **(Note: It is advisable to use rubber gloves and plastic aprons for safety and cleanliness.)**
5. After the entire stencil has been adhered, it must be allowed to dry. A fan may be used to accelerate the drying. Normal drying time is about 20 minutes.
6. When the stencil has dried, the backing material must be peeled off. This should be done very carefully to reduce the possibility of removing any of the gelatinous material on the screen.
7. The nonprinting areas of the screen must now be blocked out to prevent ink flow through these areas. This can be done by using gummed tape and kraft paper.

D. Printing the stencil (Trans. G6-4)

To assure proper registration for the second color, **do not remove the registration guides or disassemble the screen frame and base of the unit until after the second or last color has been printed.**

1. Cleaning and removing the stencil. Lacquer-base film is soluble in lacquer thinner. Before removing the stencil from the screen, remove all of the ink. The ink used for the lacquer film stencil is water-soluble and should be cleaned with water.

   To remove the stencil, first place several layers of newspaper on the printing base, and lower the screen frame to contact the newspaper. Pour a small quantity of lacquer thinner on the stencil and rub with a rag or paper towels. As the stencil dissolves, it will be absorbed by the newspaper. Because of this, it will be necessary to change the layers of newspaper under the screen frame periodically. Continue to use lacquer thinner on the stencil until all traces of the stencil have been removed from the screen.
2. Aqua film requires the same procedure used for lacquer film. But lacquer thinner is used to remove the ink, and water is used to remove the stencil from the screen.

E. Adhering second color

After removing the first stencil from the screen, the second color stencil can be adhered. Follow the same procedures for adhering, blocking out, cleaning, and removing the stencil that were used for the first stencil.

MATERIALS FOR STUDENTS

Have students save their newspapers and bring them to class. A great deal of newspaper is required to remove the paper and film stencils from the screen. The rest of the materials are mentioned in the outline.

SUGGESTED STUDENT ACTIVITIES

The student activities are explained in the sentence outline.

Vocabulary Worksheet

1. dry rack

2. screen frame

3. side kick

4. tite-stretch tool

5. ink spatula

6. squeegee

7. silk

8. stencil

9. base

TEST

Unit 6: Screen Process Printing

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Common fabrics for screen process printing are—

A. silk, organdy
B. cotton, linen
C. nylon, stainless steel cloth
D. all of the above

___ 2. The silk can be attached to the frame by—

A. the staple or cord method
B. the glue or nailed method
C. the ironed or pressure method
D. the heat transfer or fused method

___ 3. The silk, prior to framing, should be—

A. washed in warm water
B. washed in cold water
C. dry cleaned
D. boiled

___ 4. One of the easiest methods of stencil printing is—

A. kraft paper stenciling
B. tissue paper stenciling
C. mimeographing
D. spirit duplicating

___ 5. The most common types of material for making stencils in a gelatinous film are—

A. plastic and wax film
B. mylar and pylar film
C. Plus-X and Tri-X film
D. aqua and lacquer film

___ 6. The design or drawing should be drawn to—

A. actual size and backwards
B. actual size and corractly read forward
C. half size and backwards
D. half size and correctly read forward

___ 7. To cut the stencil, you should use—

A. a sharp stencil knife
B. a single-edge razor blade
C. an X-acto knife
D. any of the above

___ 8. When adhering the film onto the screen, you should—

A. rub the film
B. pour solvent over the film
C. pour water over the film
D. not rub the film since this will "burn" it

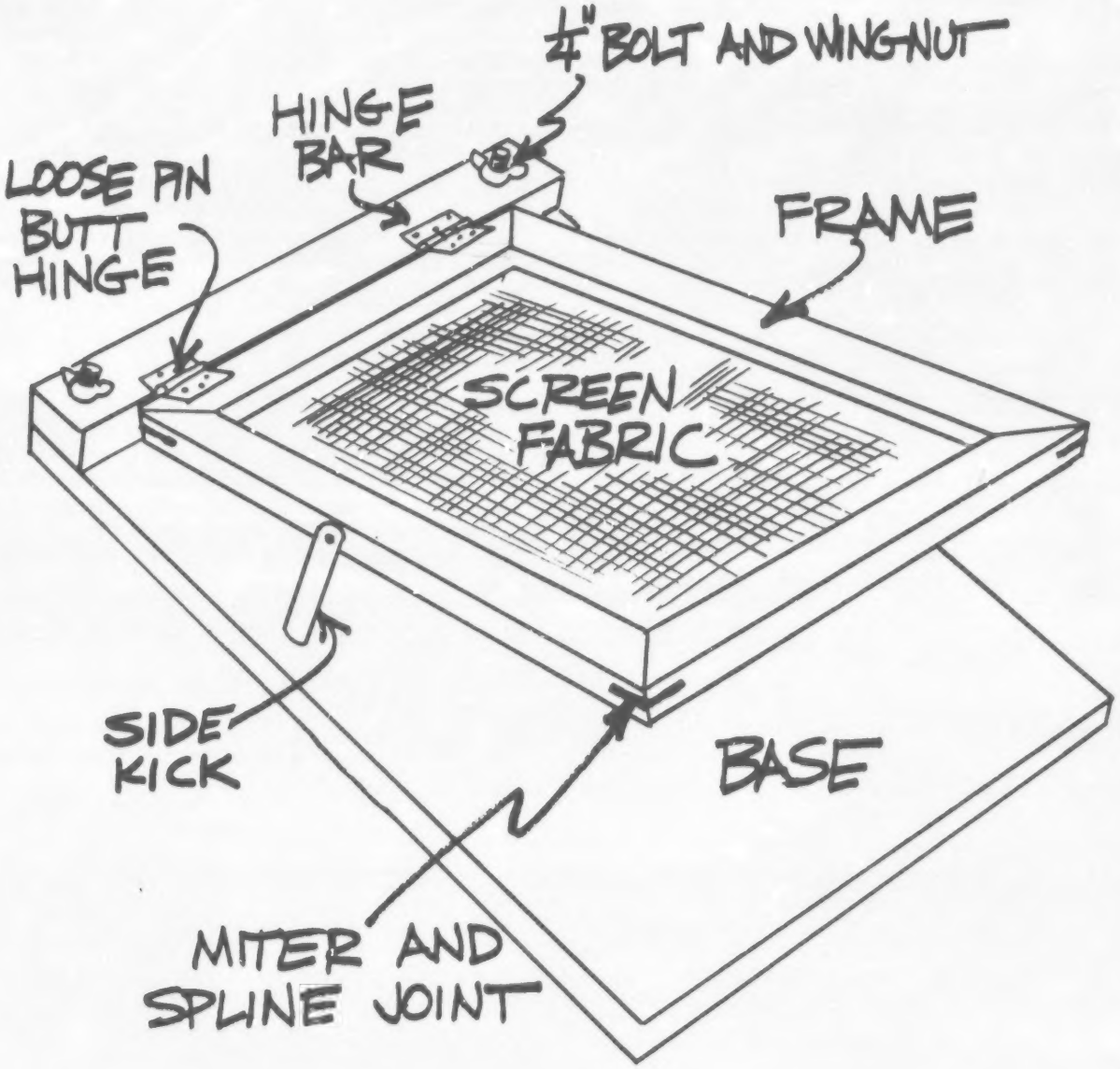
___ 9. Lacquer film is soluble in—

A. lacquer thinner
B. paint thinner
C. gasoline
D. water

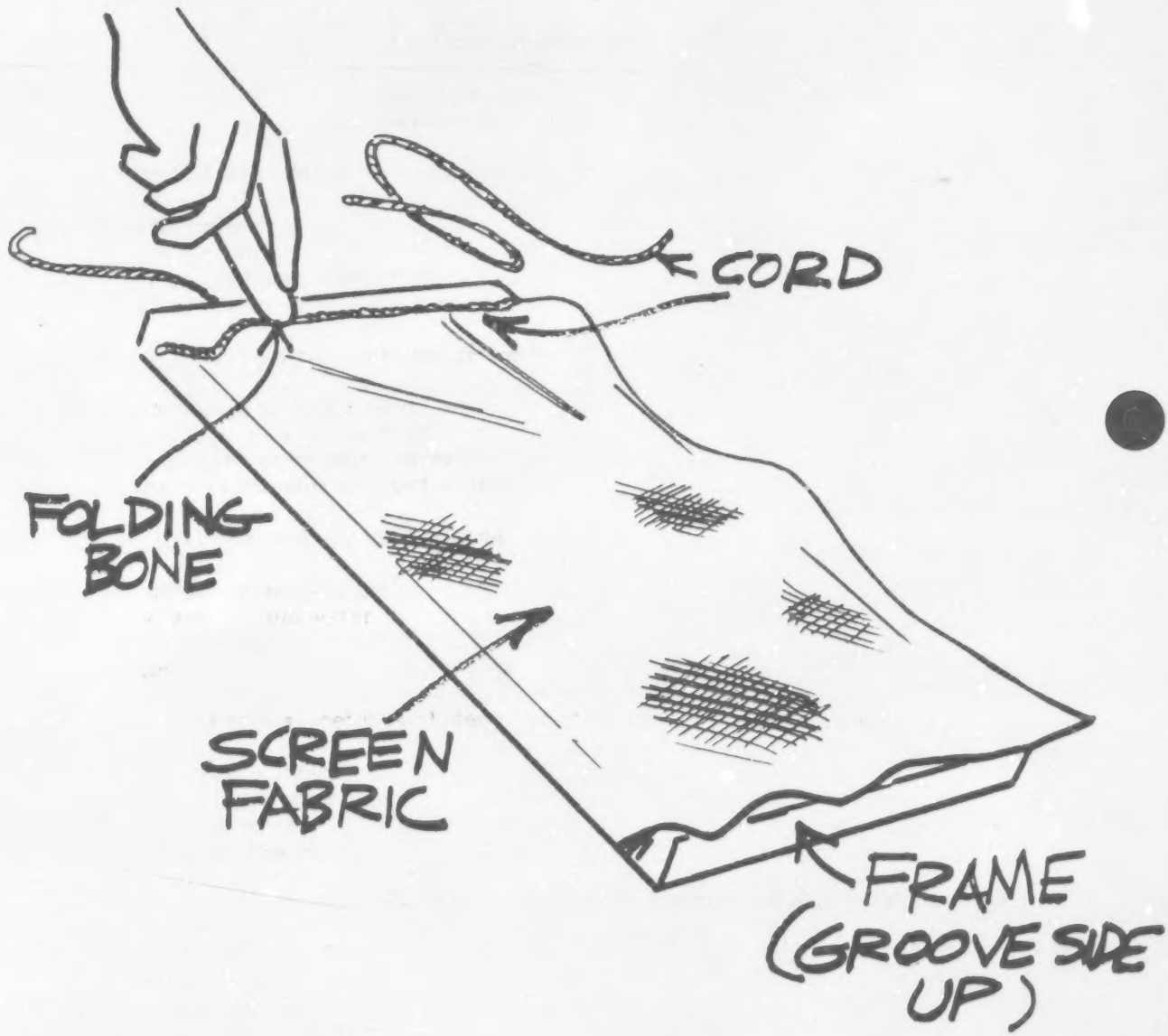
___ 10. Aqua film is soluble in—

A. lacquer thinner
B. paint thinner
C. gasoline
D. water

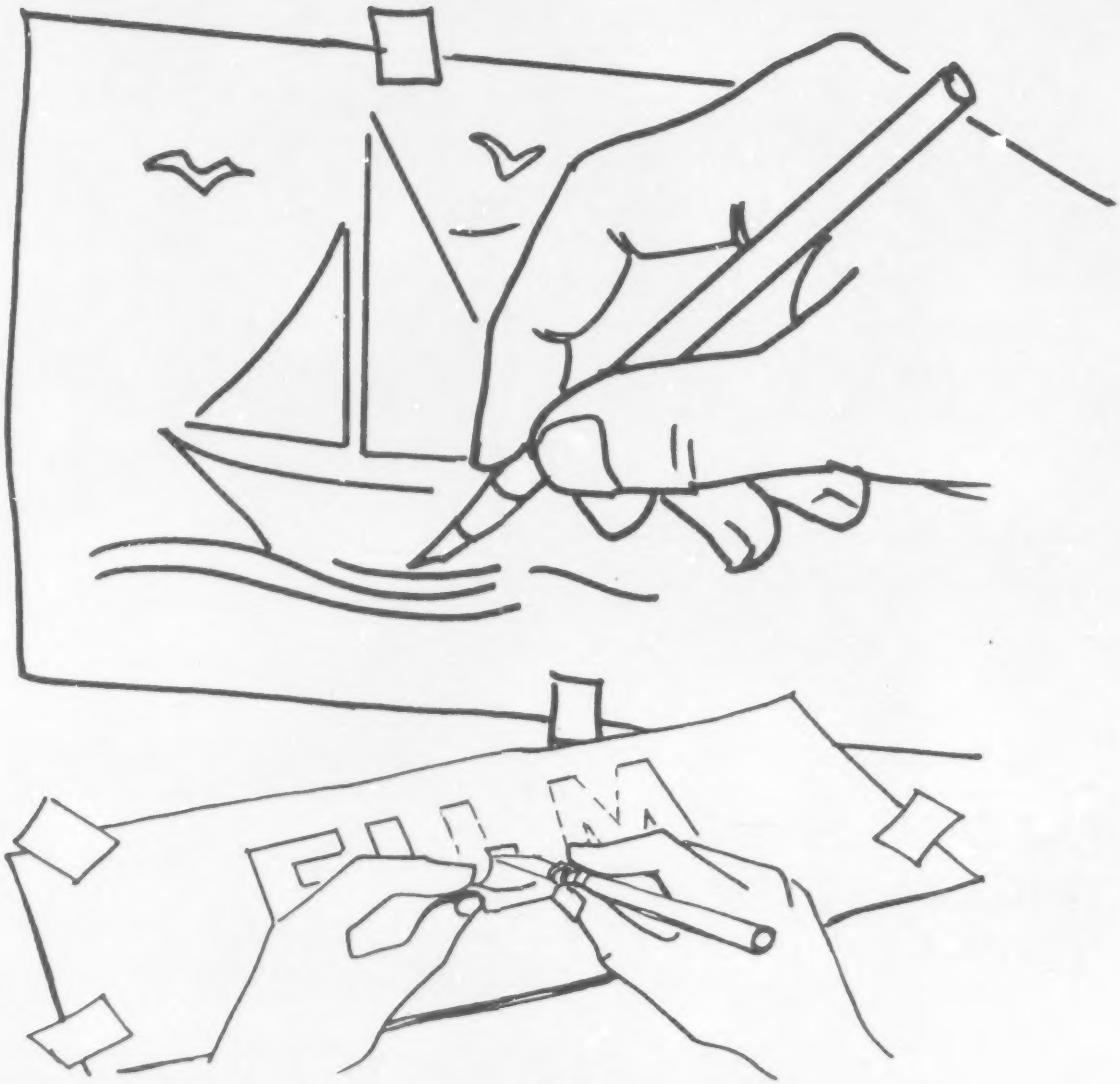
SILK-SCREEN PRINTING EQUIPMENT



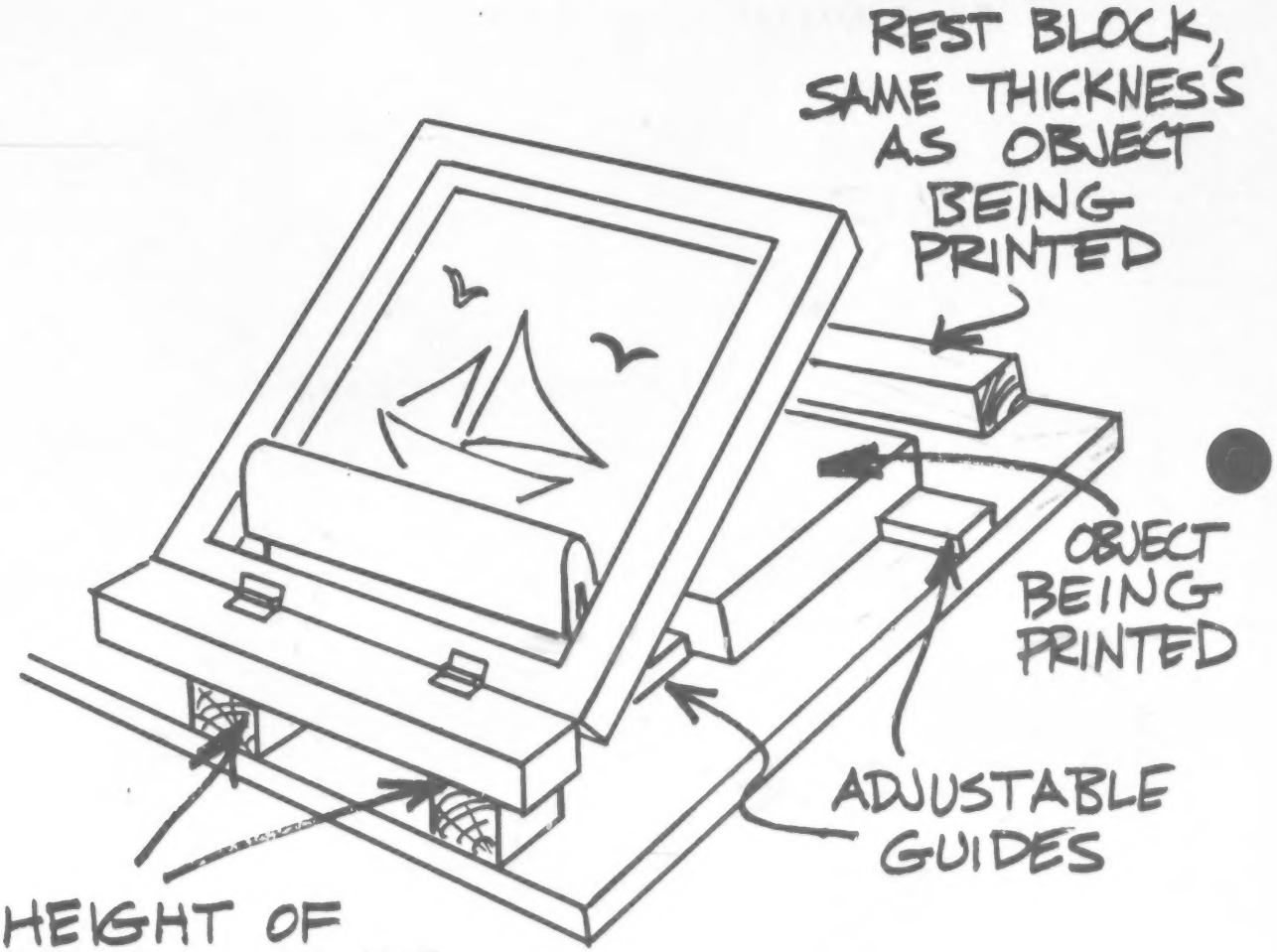
STRETCHING THE SCREEN
(TITE-STRETCH METHOD)



CUTTING THE STENCIL FILM



PRINTING THE STENCIL


REST BLOCK, SAME THICKNESS AS OBJECT BEING PRINTED
OBJECT BEING PRINTED
ADJUSTABLE GUIDES
HEIGHT OF BLOCKS SAME THICKNESS AS OBJECT BEING PRINTED

7 Planographic Printing

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. research and identify the lithographic/offset process and its origin;
2. explain the basic principle of lithography; and
3. list and explain the steps in the complete cycle of offset printing.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

lithography
flatbed press
offset press/duplicator
offset printing
copy preparation

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-D, 2-A, 3-C, 4-C, 5-A, 6-B, 7-D, 8-A, 9-B, 10-C, 11-D
- Transparencies: You will find transparencies G7-1 through G7-6 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.
  - G7-1: Stone Lithography Was Discovered by Senefelder in 1796
  - G7-2: Lithography Is Based on the Principle that Oil Will Not Mix With Water
  - G7-3: Until Lithography, Designs Were Drawn in Reverse So That the Prints Would Read Forward
  - G7-4: An Early Flatbed Press
  - G7-5: Principle of Offset Lithography
  - G7-6: The Offset Process

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Broekhuizen, Richard J. Graphic Communications. Bloomington, Ill.: McKnight Publishing Company, 1979.

Cogoli, John E. Photo-Offset Fundamentals. Bloomington, Ill.: McKnight Publishing Company, 1980.

Dennis, Ervin A. Lithographic Technology. Indianapolis, Ind.: Bobbs-Merrill Educational Publishing, 1980.

Hird, Kenneth F. Introduction to Photo-Offset Lithography. Peoria, Ill.: Charles A. Bennett Company, 1981.

Lathrop, Irvin, and Kunst, Robert. Photo-Offset. Chicago: American Technical Society, 1979.

Prust, Z. A. Photo-Offset Lithography. South Holland, Ill.: Goodheart-Willcox Company, 1977.

SENTENCE OUTLINE

I. Offset lithography
   Offset lithography is a practical outgrowth of old-fashioned stone lithography. Stone lithography, of course, is not new. It was discovered in Europe in 1796 by a man named Alois Senefelder. He found, quite by accident, that if he wrote with a grease pencil on a certain type of stone and then wet the stone with water, he could apply ink to the greasy image without inking up the rest of the stone. He could then make as many prints as he desired by simply wetting and reinking the stone before each impression. He called the process "lithography," which means stone writing (Transparency G7-1).

II. Basic principles
   A. Lithography is based on the simple principle that oil will not mix with water. An example will help make this clear (Trans. G7-2).
   B. Suppose you added some red ink to a pan of water. What would happen? The water would turn red. But if you poured some thin oil paint into the pan, the water would not be affected because oil and water will not mix.
   C. Since the two will not mix, the color would float on the surface of the water in a kind of greasy design. It would be a simple matter to transfer this design to paper. If a sheet of paper

were placed on the water, it would absorb the color.

D. This system is used in binderies for "marbelizing" the edges of books. The bookbinder pours oil paints into a container of water and stirs it to produce various designs. Then he or she clamps the book tightly so that the colors will not seep between the pages, and touches the edges of the book to the colors on the water. The paper absorbs the colors, and a beautiful marbelized design is produced.

E. This marbelizing process is similar in principle to lithographic printing. Because the water is fluid, however, the image is unstable. It is therefore impossible to produce a series of prints that are exactly alike in design. Since a stable image is required for producing like designs, the image must be fixed or anchored to a solid material, such as the lithographic stone or plate.

III. Stone Age of lithography

A. For many years after Senefelder's discovery, the stone was used exclusively as the master plate in making lithographic prints. With the introduction of zinc and aluminum plates, however, popularity of the stone waned fast. Today, it is rarely used.

B. The original lithographic stones were of a limestone whose qualities were especially suitable for lithographic printing. These stones absorbed grease readily and were porous enough to hold moisture, yet they provided a smooth working surface. They came in sizes of up to 44 x 62 inches and were often from 3 to 5 inches thick. Stones like these often weighed more than half a ton.

C. All printing matter was drawn on these stones by hand. The designs were drawn in reverse so that the prints would correctly read forward (Trans. G7-3). You may want to demonstrate directly on a press.

D. The following method is used: On a sheet of paper, print the word backwards with a soft lead pencil. Lay another sheet of paper over it, and rub the back of the second sheet with your pencil as shown. You will find that the word will transfer to the second sheet in positive or readable form. The more complex lithographic designs were reversed in this same manner.

IV. Presses

A. **Flatbed presses**

Lithographic printing, as you have just seen, requires moistening the stone and reinking it before each impression. These operations had to be done by hand on the first crude lithographic presses. These presses were known as "flatbed" presses because the lithographic stone rested on a flatbed. Two printers had to work hard to turn out 1,000 impressions a day on such a press (Trans. G7-4).

B. Cylinder press

Lithographic presses were equipped later with an automatic dampening and inking roller, as well as a cylinder for carrying the paper. The stone was placed on the flatbed, which shuttled back and forth alternately under the dampening and inking rollers and the impression cylinder which carried the paper. The cylinder revolved at the same rate of speed as the bed and pressed the paper against the stone to make the impression. These automatic cylinder presses increased production to 5,000 or 6,000 impressions per day. They were the forerunners of the modern, high-speed offset presses used today.

C. Rotary **presses**

1. Lithography quickly became a means of producing artwork, pictures, maps, and posters in full colors. But regular, black-and-white lithographic processes were too slow and expensive to offer any real competition to the already established letterpress process. Commercially, lithography was viewed with interest, but with little enthusiasm.
2. Lithography gained ground, however, with the coming of zinc and aluminum plates. When properly treated, these plates could absorb grease and water just as well as the lithographic stone. Unlike stone, they were also light and pliable and could be fastened easily around a cylinder.
3. Experiments with them led to the

development of the rotary press. This press consisted of two cylinders, one rotating clockwise and the other counterclockwise. The plate was carried on one and the paper on the other. They were synchronized to meet at the same rate of speed and thus produced an even impression. This new type of press raised production to approximately 1,000 impressions per hour.

V. Photography

A. Soon after the development of photography in 1839, lithographers began using it to produce images on their stone. By 1860, zinc plates were being reproduced successfully with the aid of the camera. This working partnership between photography and lithography became known as photolith or photolithography.

B. In spite of its early advances, photography was not generally used for producing lithographic plates until the turn of the century. It has developed quickly in recent years. Now it is used extensively in graphic arts reproduction shops and by large and small business organizations.

C. It is important to remember that all the printing discussed thus far has been direct printing, in which impressions are made on paper directly from a stone or plate. All lithographic printing was done like this until 1906 when Ira Rubel, a lithographer at Nutley, New Jersey, conceived the idea for developing an **offset press** or **duplicator.**

D. As with Senefelder and the limestone, fate stepped in to lend a hand. It all started one afternoon while Rubel was watching paper being fed into a cylinder press. The feeder missed feeding a sheet of paper, and the plate made its impression on the cylinder backing. Naturally, the next sheet fed through printed on both sides. (The plate pressed the paper against the cylinder backing. The fresh ink left there by the previous impression was offset onto the back of the sheet.)

E. This gave Rubel an idea. Shortly thereafter, he came up with a new type of press that "offset" the image to the paper instead of printing it on directly. **It is important that you understand this principle, which governs the theory of offset lithography.**

F. The printing unit consists of an ink fountain and rollers, a water fountain and rollers, and three large, metal cylinders (Trans. G7-5). The plate is attached to the top cylinder. A rubber blanket is attached to the center cylinder. The bottom cylinder carries the paper through the press, forcing it against the rubber blanket to make the printed impression.

G. When the press is turned on, the cylinders revolve. The plate is carried first under the dampening rollers, then under the inking rollers, and finally against the rubber blanket. The dampening rollers thus keep the nonprinting areas of the plate wet so that they will not take the ink when the plate passes under the ink rollers. As a result, only the image is inked. After the plate passes under the ink rollers, it contacts the blanket cylinder, transferring the inked image to the blanket. The blanket, in turn, offsets or prints the inked image on the paper, which is forced against it by the impression cylinder.

H. You will recall that, in direct lithographic printing, the image is drawn on the plate in reverse so that it will print in readable form on the paper. **Offset printing** works in just the opposite manner. The image faces right side up at the start so that the impression is made on the blanket in reverse. The blanket then offsets an image which reads correctly on the paper.

I. Lithographic processes are called by many different names, including planography, zincography, photolith, and photolithography. These names sound confusing. But they needn't be because most of them are just variations of the same process. It is important to know that, if a job is printed on an offset press from a lithographic plate, it is called offset printing. If photography is used in making this plate, it becomes photo-offset printing. It is not photo-offset or photolithography, however, unless photography is involved.

VI. The complete cycle (Trans. G7-6)

By now, you probably know many isolated bits of information on lithography. So let's fit the pieces together and see just what goes on in a lithographic plant.

A. Planning and production

Planning the work is the first step. The lithographer must study each job and decide how it can best be produced with the equipment on hand. Sometimes the lithographer sketches the material or lays it out in rough visual form to show the positions of the type and illustrations on the page. He or she may also prepare a worksheet to show such pertinent information as the color of ink, type of paper to be used, the size of the page, and the number of copies required.

B. Copy preparation

Following closely is the second step, called copy preparation or production. It consists of such operations as drawing illustrations, retouching photographs, typing the text, pulling proofs from type, and pasting all the work together or assembling it for the camera.

C. From copy to film

The third step takes place in the camera room. Here, the camera operator fastens the work to a large copyboard and photographs or copies it with the camera. He or she then develops the film (negative) and sends it to the stripping department. Here, it is examined for defects and corrected or retouched, if necessary. Several negatives may then be stripped or taped together in their proper printing positions on a sheet of orange paper. Windows are cut in the paper to expose the printing (transparent) areas of the negatives. These areas will then print on the plate, but the areas marked off by the orange paper will not.

D. Making the plate

The next step occurs in the plate room. Here, the platemaker operator takes a thin aluminum or paper plate that has been coated with a thin film of light-sensitive emulsion. He or she places it in a vacuum printing frame and positions the negative assembly over it. Then it is exposed to a bright light.

During the exposure, the light passes through the transparent areas of the negative and hardens the coating on the plate wherever it strikes. After the exposure is ended, the operator removes the plate from the printing frame, covers it with a thin coating of ink, and flushes it in plain water. The water dissolves the unhardened areas of the coating. But the light-hardened inked-over areas remain on the plate as the printing image.

E. Going to press

The plate is then sent to the press room where it is clamped on the cylinder of the offset press. You have already learned how impressions are made on the press.

SUGGESTED STUDENT ACTIVITIES (to be completed in sequence)

1. If an offset **duplicator** is available, have the students study the operator's manual and learn the steps to run the duplicator. (Basic process photography, stripping and platemaking, and planographic printing information are in Photo-Offset Fundamentals by Cogoli and other photo-offset texts.)
2. Have students design a finished graphic product, such as note sheets, stationery, or flyers.
3. Combine the elements to prepare an offset plate.
4. Operate the offset duplicator, and reproduce 50 clean copies.

Vocabulary Worksheet

1. lithography

2. flatbed press

3. offset press/duplicator

4. offset printing

5. copy preparation

TEST

Unit 7: Planographic Printing

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Lithography means—

A. wetting and reinking
B. printing with pictures
C. writing with rocks
D. stone writing

___ 2. Lithography is based on the principle that—

A. oil will not mix with water
B. oil will mix with water
C. oil is lighter than water
D. oil is heavier than water

___ 3. Lithography was discovered by—

A. Johann Gutenberg
B. Thomas Edison
C. Alois Senefelder
D. John E. Cogoli

___ 4. The earliest presses that used the lithographic process were—

A. rotary presses
B. cylinder presses
C. flatbed presses
D. offset duplicators

___ 5. Rotary presses use—

A. two cylinders to transfer the image
B. no cylinders to transfer the image
C. all cylinders to transfer the image
D. none of the above

___ 6. The term "offset" is used because—

A. the image is adjusted about 1/4 inch
B. the image is first transferred to one cylinder, then to another
C. the image is transferred to three different cylinders
D. the image is transferred to five different cylinders

___ 7. Lithographic processes are called by many different names, including—

A. planography, zincography
B. photolith, photolithography
C. offset printing, photolithography
D. all of the above

___ 8. The first step of the complete cycle in a lithographic plant is—

A. planning
B. copy preparation
C. copy to film
D. making the plate

___ 9. The second step in a lithographic plant is—

A. planning
B. copy preparation
C. copy to film
D. making the plate

___ 10. The third step in a lithographic plant is—

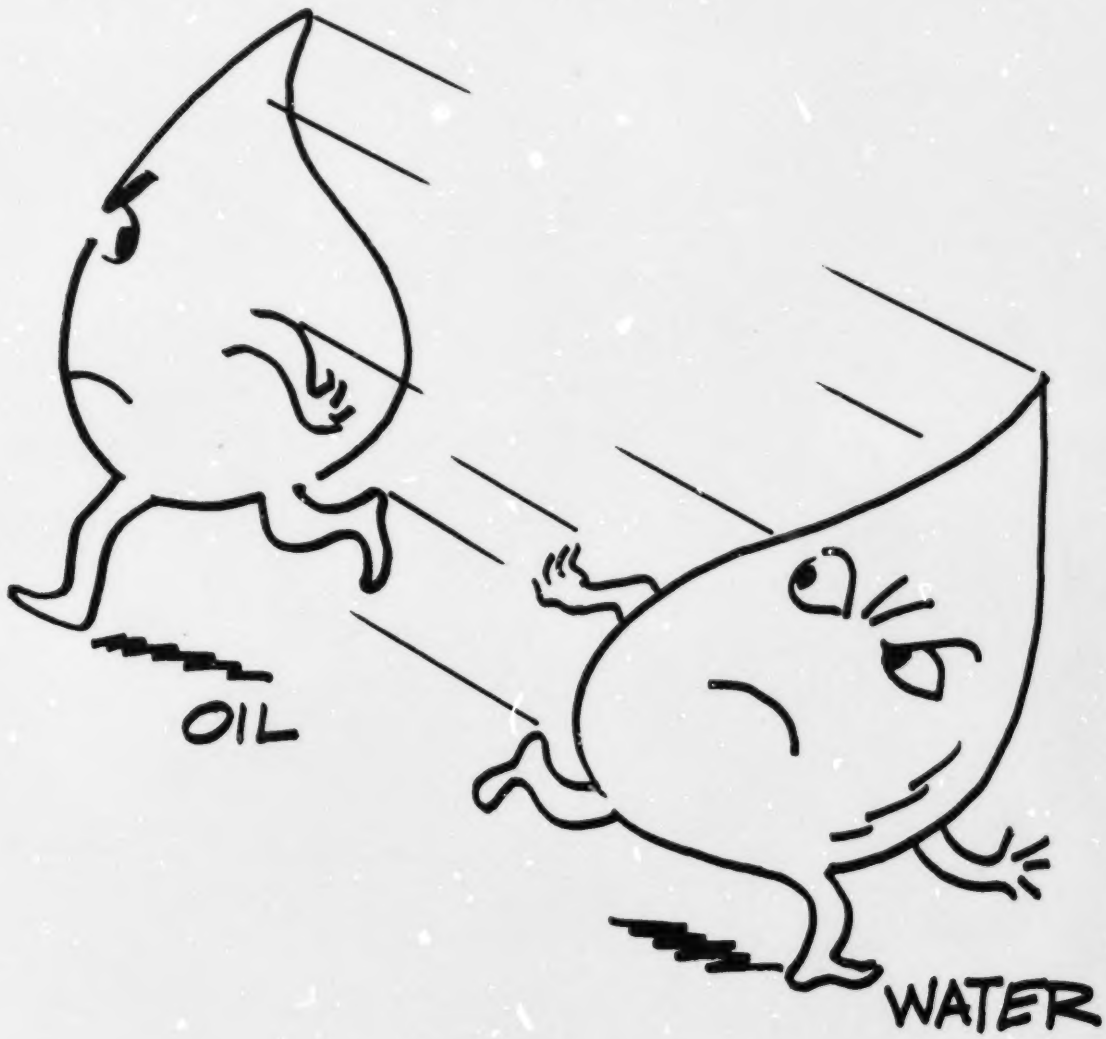
A. planning
B. copy preparation
C. copy to film
D. making the plate

___ 11. The fourth step in a lithographic plant is—

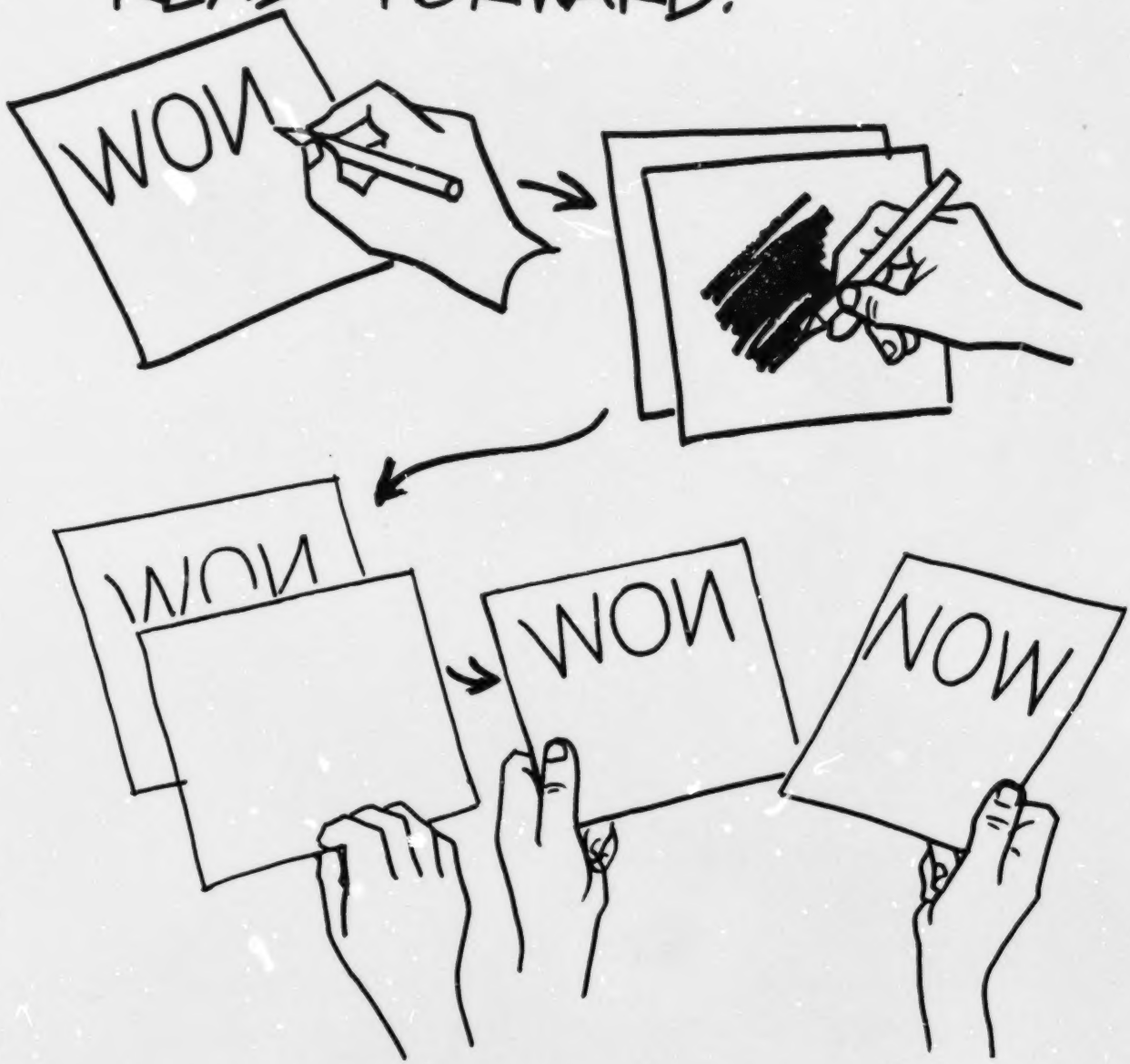
A. planning
B. copy preparation
C. copy to film
D. making the plate

STONE LITHOGRAPHY WAS DISCOVERED BY SENEFELDER IN 1796

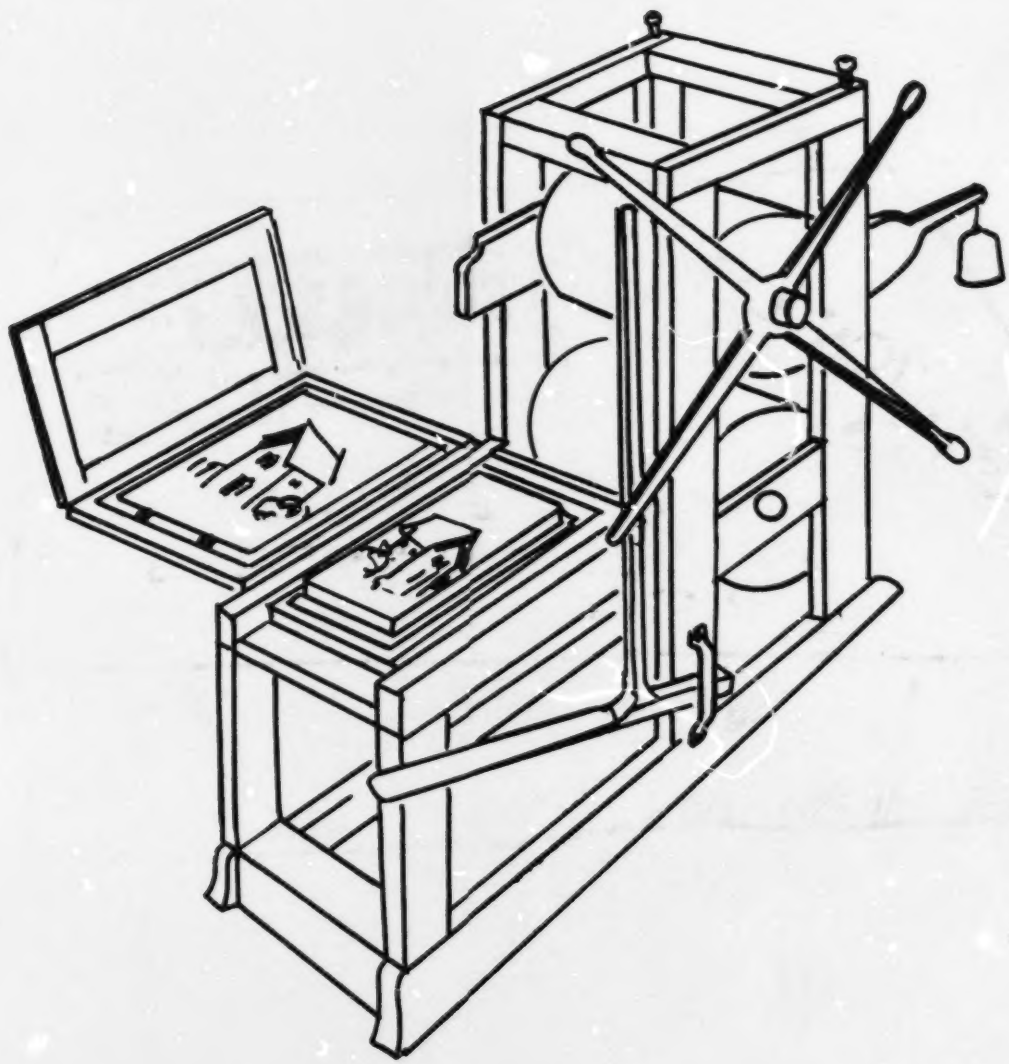
LITHOGRAPHY IS BASED ON THE PRINCIPLE THAT OIL WILL NOT MIX WITH WATER.



UNTIL LITHOGRAPHY, DESIGNS WERE DRAWN IN REVERSE SO THAT THE PRINTS WOULD READ FORWARD.



AN EARLY FLATBED PRESS



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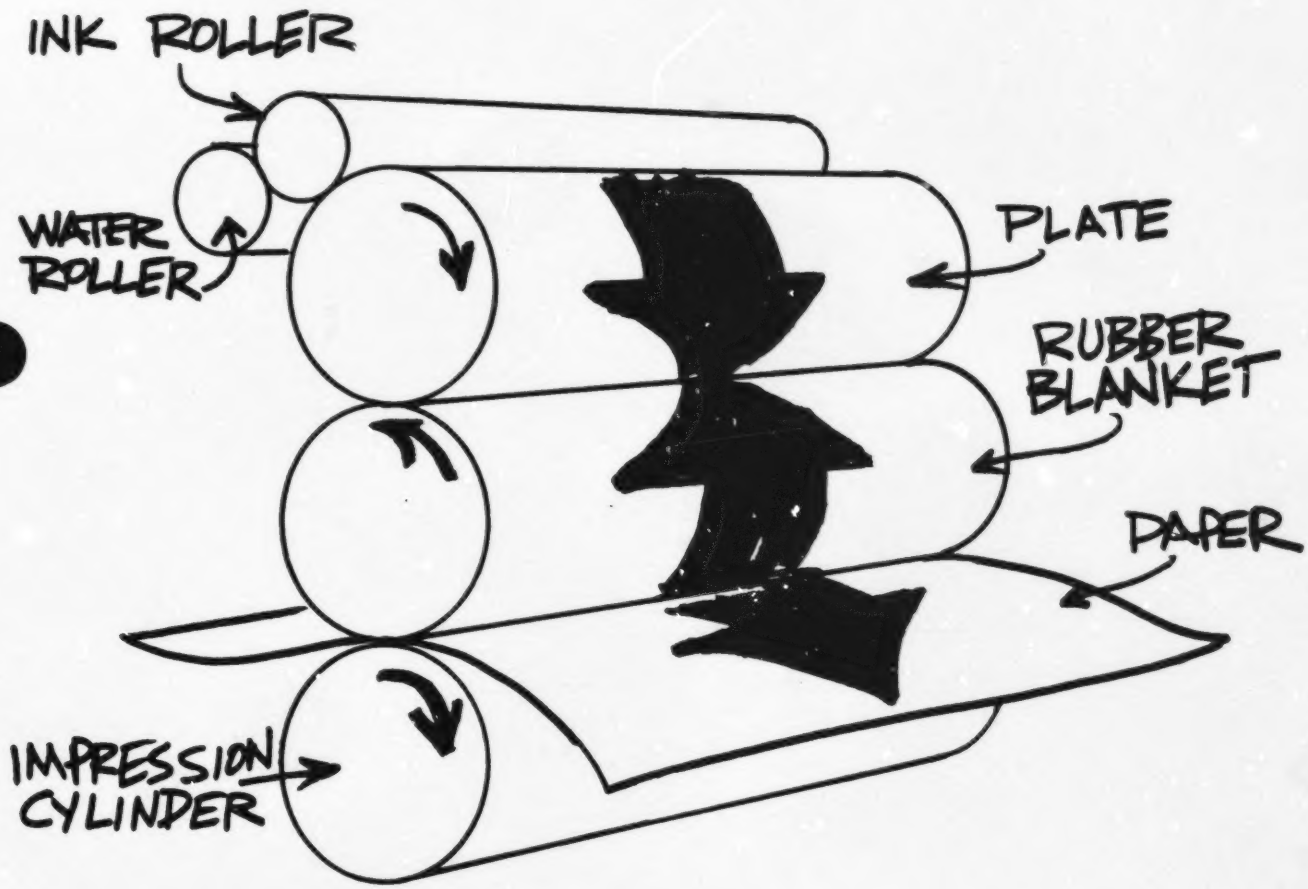
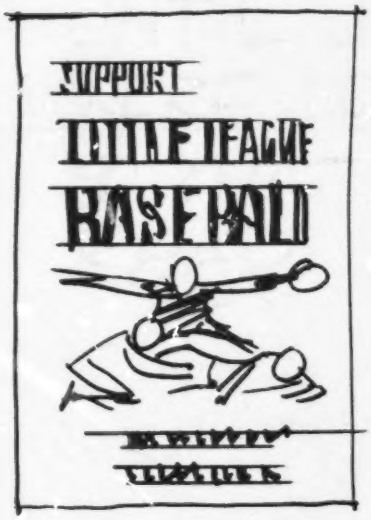
G7-4

PRINCIPLE OF OFFSET LITHOGRAPHY

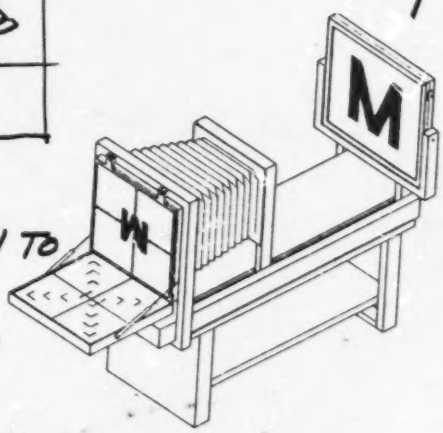


THE OFFSET PROCESS



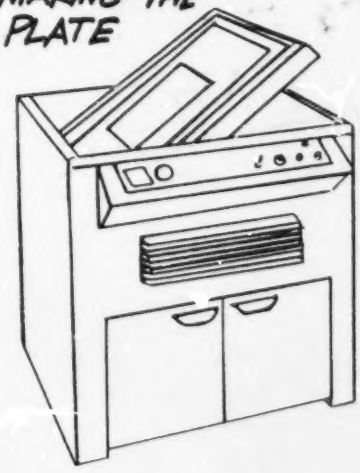
1. PLANNING & PRODUCTION

2. COPY PREPARATION

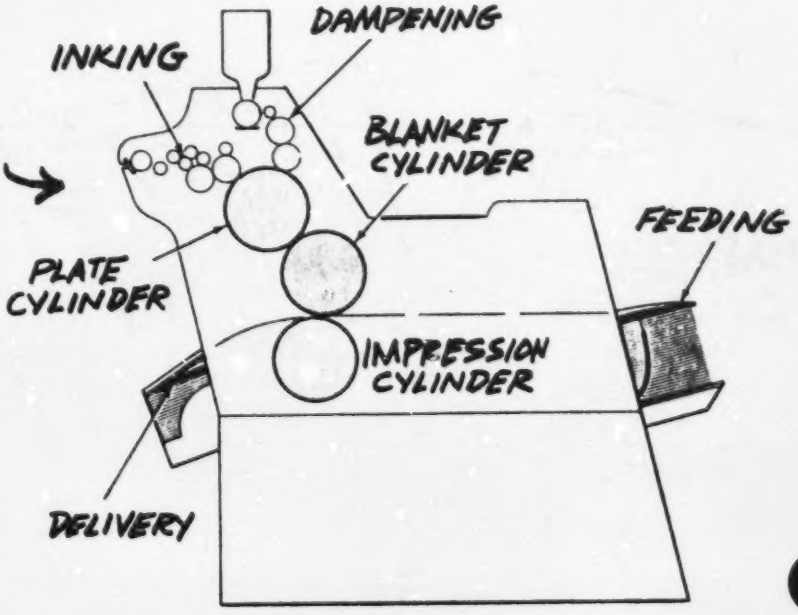


3. FROM COPY TO FILM

4. MAKING THE PLATE



5. GOING TO PRESS



8 Finishing and Binding

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify and explain the various approaches to binding printed material; and
2. demonstrate basic finishing and binding techniques.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying graphic arts. Teachers should help students understand these words as they are used in this topic of study.

contents	super
end papers	saddle stitching
headbands	side stitching
marbling	cover boards
signatures	cord
spine	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A and B.
- Test Key: 1-B, 2-D, 3-B, 4-D, 5-D, 6-A
- Transparencies: You will find transparencies G8-1 through G8-3 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  G8-1: Bookbinding—Parts of a Book
  G8-2: Conventional Binding Methods
  G8-3: Binding Methods

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Bannister, Manly. Bookbinding as a Handcraft.

Dennis, Ervin A. Lithographic Technology. Indianapolis, Ind.: Bobbs-Merrill Educational Publishing, 1980.

Spence, William P., and Vequist, David. Graphic Reproduction. Peoria, Ill.: Charles A. Bennett Company, 1980.

SENTENCE OUTLINE

I. Introduction
   A. A book is composed of many parts that are vital to its construction. The **contents** is the main body of the book. It is made up of sections called **signatures**, fastened together at the spine. These signatures are formed by folding a sheet of paper one or more times, an octavo, or four times, a sextodecimo. The number of sheets in a single signature depends on the thickness of the paper. With thicker paper, if too many sheets are used, the signature will be thick and awkward. The paper is always cut so that the grain runs vertically, parallel with the back of the book.
   B. **End papers** are folded sheets of paper that are placed on either side of the assembled signatures to form a lining for the inside of the **cover boards** and also the flyleaf. The **super** is a mesh cloth or muslin placed across the spine, extending out on either side to form a hinge for joining the cover to the book (Transparency G8-1). The joint is at the edge of the cover boards where they meet the back of the book.

      Headbands and tailbands are applied at the top and bottom of the spine to produce a more finished appearance. The term "headband" is often used to refer to both. They are also called band strips. The fore edge or front edge is the side opposite the back or folded parts of the book. The back of the book, including the part where the folded and sewn sections are glued together, is called the **spine**. The cover boards are cardboards placed on the outside of the book to form the cover.

II. Bookbinding materials
   A. Papers

      A variety of papers is needed for the selection of book pages, covers, and lining sheets. Common and easily available papers like bond white drawing, cream manila, and colored text and Japanese rice papers are some of the many possibilities. Wax paper is

used to protect the book and keep it clean. It also prevents the moisture of the paste from going through the book while it is being pressed.

B. Book cloth
Book cloth is a material used over the cardboard covers of a book. It may be any fairly heavy fabric, such as linen, sailcloth, burlap, denim, light tapestry, woven straw cloth, or wallpaper, which has a pleasing textural quality.

C. Adhesives
Several milky, latex rubber-base glues are available on the market for bookbinding. Certain casein glues will even stick to book cloth that has a glossy, treated surface. Strong vegetable glue that can be thinned with water to the desired consistency is also available. It is desirable to use flexible glue on the spine of a book to hold the sewn sections together. This keeps the spine from drying out and prevents cracking when the book is opened. This glue can be purchased as a liquid or in gelatin form. The gelatin glue must be kept wrapped in heavy wax paper in order to retain its softness. Padding and tabbing cements and rubbery compounds used commercially in making scratch pads are very strong. They can replace other strong glues when a series of magazines are bound together. They are available in a red or white liquid. If you desire, you can add food coloring to the white to get desired effects.

D. **Cover boards**
Cover boards of various kinds, used as covers for books, portfolios, and similar constructions, are usually referred to as "boards."

Professional hand binders generally use a binder's board called tar board, which is tough, strong, and very rigid. This type of board is recommended for books sewn on a card that is laced into the cover. A board 1/16 or 3/32 inch thick is suitable for most work. Tablet backs, shirt cardboards from laundries, and discarded advertising display cards are sources to consider. If the cardboard is too thin and flimsy, two or more pieces can be glued together and pressed to form a good, rigid board.

E. Mending tissue
Strips of thin paper about 5/8-inch wide are used for mending tears and weak places in the folded parts of pages when doing rebinding. Japanese mending tissue is purchased in strips or rolls, or tissue can be cut from very thin paper, such as onionskin.

F. Tape
The signatures that make up a book are sometimes sewn on tapes. This helps to hold them together and to secure the contents to the cover. Unbleached or white twill cotton tape is available from bookbinding supply sources in 3/8- to 1/2-inch or 5/8-inch widths.

G. **Cord**
Book sections can be held together with cord as well as tape. The cord looks like a hemp rope and comes in different thicknesses, and is rolled into a ball. A thick cord is used when raised effects are desired on the spine, while a thinner cord can be flat or sunken. If regular bookbinding cord is not available, any cord that is not twisted too hard and can be frayed out at the ends will suffice. Hempen cord, light rope hemp, or thick string are good examples.

H. Thread
An unbleached linen thread is used by binders to sew signatures. For average work, size 16/2 is recommended. This comes in cones or in 1/2-ounce skeins. Strong cotton thread of size number 10 to 12, button thread, cotton crochet, or embroidery silk can serve as substitutes.

I. **Super**
Super is a material used on the back of a book, after the signatures have been glued together. It helps to form a hinge. Bookbinder's super is sold by the bolt, either narrow or wide. The kind used for average book jobs is a thin, stiffened mesh that looks like cheesecloth. Other materials that can be used for this purpose are cambric, unbleached muslin, crinoline, buckram, or tarlatan.

J. **Headbands**
Commercially made headbands, placed at the top and bottom of the book to give it a tailored finish, are available

in different colors. They are sold by the yard or bolt, about 1/2 inch or less in width. Many methods of fastening sheets are available, and you will become acquainted with these different processes, and their advantages and disadvantages. The conventional binding methods include saddle stitching, side stitching, sewn soft cover, and sewn case-bound. **Saddle stitching** is one of the cheapest methods of fastening small booklets (8 to 30 pages). The sheets are stapled together through the middle fold of the paper. An example of this is the T.V. Guide (Trans. G8-2).

Side Stitching is another method that is very inexpensive and is used mainly for small booklets. The staples are placed through the paper near the left-hand edge of the paper. The disadvantage of this is that the booklet does not lie flat when opened. Sewn soft cover is a more expensive method than the preceding wire stitching methods. Each signature is sewn together, and a soft cover is glued in one piece to the front and back of the sewn book. Single sheets can be sewn together and a soft cover applied. This method is used for pocket book editions. The sewn, case-bound binding is the best process and is, of course, the most expensive. The pages are sewn together, either in signatures or as single sheets. A hard covering or casing is placed on the back, usually binder's board covered with cloth. Most textbooks are produced by this method.

The mechanical binding processes include such methods as post or ring binders, plastic binding, and spiral binding. Using binding posts, holes are drilled in the paper, and the posts are inserted. This type of binding does not lie flat when the book is open, and pages are not too easily removed or added. Ring binders are most popular and are used by students in schools and colleges. The sheets lie flat when the binder is open. Sheets can be removed or added easily. Plastic bindings consist of a cylindrical device that holds the sheets with a multitude of plastic rings. Sheets can be added to this binding as well as be removed (Trans. G8-3). Spiral bindings are made of a simple spiral wire coil that runs through small, round holes punched in the sheets. With both plastic and spiral bindings, books lie flat when opened.

K. **Marbling**

For marbled paper effects, colors that are not soluble in water such as oil paints or printer's ink, are used. These colors are mixed individually in small jars with turpentine to the consistency of thin cream. Then, they are carefully dropped onto the surface of a pan of plain water. A brush can be used for flipping the paint on in small spots. A shallow trough, such as a tray or cookie tin, is used to hold the water. A deeper pan can also be used if it has a wide enough surface upon which to lay the paper.

If the paints are thinned too much or not enough, they will either be absorbed by the water or drop to the bottom of the pan. A little experimentation will help determine the consistency needed. The paint on the water is stirred slightly with a wooden stick, spatula, or brush to produce wavy lines and swirls that form various changing patterns. A sheet of paper that may be dampened first, if desired, is laid slowly on top of the water. When the paint adheres, the paper is lifted up carefully and set aside to dry. It is better if the paper can be kept on top of the water so that it does not become engulfed with too much paint. It sinks quickly, however, and must be removed almost immediately. When the sheet is dry, it can be pressed with a warm iron to flatten it.

SUGGESTED STUDENT ACTIVITIES

Student Activity A—Making A Memorandum Pad

Materials required

- (2) 5½-inch X 4-inch binder's board
- 1 piece 6½-inch X 9-inch cover material
- 1 piece 5½-inch X 8-inch lining or cover material

- 1 pad (125 sheets), 3½-inch X 5-inch
- Glue
- Case
- Scissors

Procedure:

1. Cut the binders and cover material.
2. Mark off on the cover where the binder's board will be placed.
3. Apply glue on one binder's board, and place it in position. Turn it over and smooth out all the air bubbles.
4. Apply the other board. Make sure the top edges of both boards are even.
5. Apply glue to all four corners and make a library corner. Use glue sparingly.
6. Apply glue to the top and bottom edges, and fold them over. Make sure you press firmly against the binder's board.
7. Apply glue to the sides, and press firmly.
8. Cut the lining material, and glue it to the inside of the cover.
9. Insert the filler pad in the case. A name can be placed on the front cover in gold leaf.

Student Activity B—Making an Autograph Album

Materials required:

- (2) 4¼" X 6" binder's board or poster board
- 100 sheets of 4" X 6" paper (use variety of colors)
- (2) 4¼ X 6" end sheets (folded)
- (2) 1" wide headbands
- 1 piece 5" X 14" cover material (cloth or vinyl wallpaper can be used)
- Sewing clamp
- Padding cement
- Thread
- Press
- Tape
- Chipboard
- Cloth or vinyl wallpaper
- Scissors

Procedure:

1. Cut paper for the body.
2. Place the paper in a sewing clamp, and give the 4-inch side a coat of padding cement. This helps hold the paper in place while the holes are drilled.
3. Drill holes in the paper, using the jig attached to the sewing clamp.
4. Loosen the wing nuts and move the body out over the edge about 1/4 inch and sew the body. Starting from the left side, insert the needle from the top down through the first hole and up through the second hole, and then reverse. Continue this procedure until you reach the right side and then reverse back to the left. Pull both ends of thread high and tie a double or square knot. Cut off the thread about 1/2 inch from the end.
5. Cut and fold the sheets. Apply 3/16 inch of glue on the end of the sheets, as shown in the drawing.
6. Apply the end sheets to the body and place in the press for 30 minutes.
7. Remove the body and trim.
8. Cut the binder's board to the proper size, measuring by the following method.
9. With the binder's board in position, place the tape around the end of the book so you will know how much cloth is needed around the back of the book.
10. Place the binder's board on the cloth with the tape facing up. Cut the cloth 5/8 inch larger all the way around.
11. Mark off on the cloth the location of the boards, and glue the first board to the cloth. Then glue the second board to the cloth. Make sure that the top edges of the binder's board are straight across.
12. Apply chipboard for the backbone. The size of the chipboard will be determined by the book's thickness and the binder's board's length.
13. Apply glue to the corners and make a library corner.
14. Apply a thin coat of glue to the top and bottom edges of the cover material. Turn the edges over the binder's board.
15. Apply a thin coat of glue to the sides of the cover material. Turn the edges over the binder's board.
16. Place the case in the press for 30 minutes.
17. Apply headbands at each end of the back of the book. Let them dry for 30 minutes, and then trim.
18. Place the body of the book in the case, and glue the end sheets to the binder's board. Place in the press for 30 minutes.

Student Activity C—Binding Magazines Into Book Form

Materials required:

- magazines
- 2 binder's boards
- book cloth
- 2 end sheets (folded)
- 2 headbands
- 2 or 3 sewing tapes (bias tape can be used)
- padding cement
- backing paper
- backing flannel
- sewing frame
- clamp
- tapes
- hacksaw
- needle
- thread
- padding cement
- scissors

Procedure:

1. Arrange the magazines in chronological order.
2. Remove staples, paper clips, glue, or thread.
3. Place the magazines in the clamp, and mark off where the tapes will go. The number of tapes needed will depend on the length of the magazine.
4. Cut into the marks with a hacksaw, cutting only deep enough to pierce the inside of the section.
5. Place the magazines in the sewing frame, and tack the tapes between the second and third cuts.
6. Take all magazines off the sewing frame, and place the last magazine on the frame. Open it to the center and start sewing from the right side. Insert the needle through the first cut and come out the second cut. Come around the tape on the right side, and go back inside to the left. Come out this side of the tape, around again, back inside, and come out at the end.
7. Repeat this operation with the second magazine, working from left to right. When you come out at the right end, tie the two pieces of thread together.
8. Sew the remaining magazines to the tape the same way as described in steps 6 and 7.
9. A kettle stitch is used to fasten each succeeding section to the last. The stitch is made by passing the needle between the last two magazines. Make sure that it goes behind the thread.
10. Remove the tacks and trim the tapes, leaving about 3/4 inch of tape on both ends.
11. Place magazines in the clamp, and apply a coat of padding cement. A piece of backing flannel may be applied. The size should be 1/2 inch shorter than the length and 2 inches wider than the thickness of the back.
12. Trim the body with a paper cutter.
13. Place headbands at each end of the back, and trim them.
14. Cut backing paper the width and the length of the back, and apply it to the backing flannel.
15. The next step is to make the case. Follow the steps as outlined in Student Activity B, steps 8-16.

Student Activity D—Exhibiting the Finished Products for the Entire School to View

Vocabulary Worksheet

1. end papers

2. saddle stitching

3. side stitching

4. cover boards

5. cord

6. super

7. headbands

8. marbling

9. signatures

10. contents

11. spine

TEST

Unit 8: Finishing and Binding

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Paper that is folded into pages is called—

A. super
B. signature
C. contents
D. spiral

___ 2. Books can be bound by—

A. tape, cord
B. thread, super
C. plastic binding
D. all of the above

___ 3. Super, a material used on the back of a book, is a—

A. glue
B. stiffened mesh cloth
C. thread
D. tape

___ 4. Conventional binding includes—

A. saddle stitching
B. side stitching
C. sewn soft cover
D. all of the above

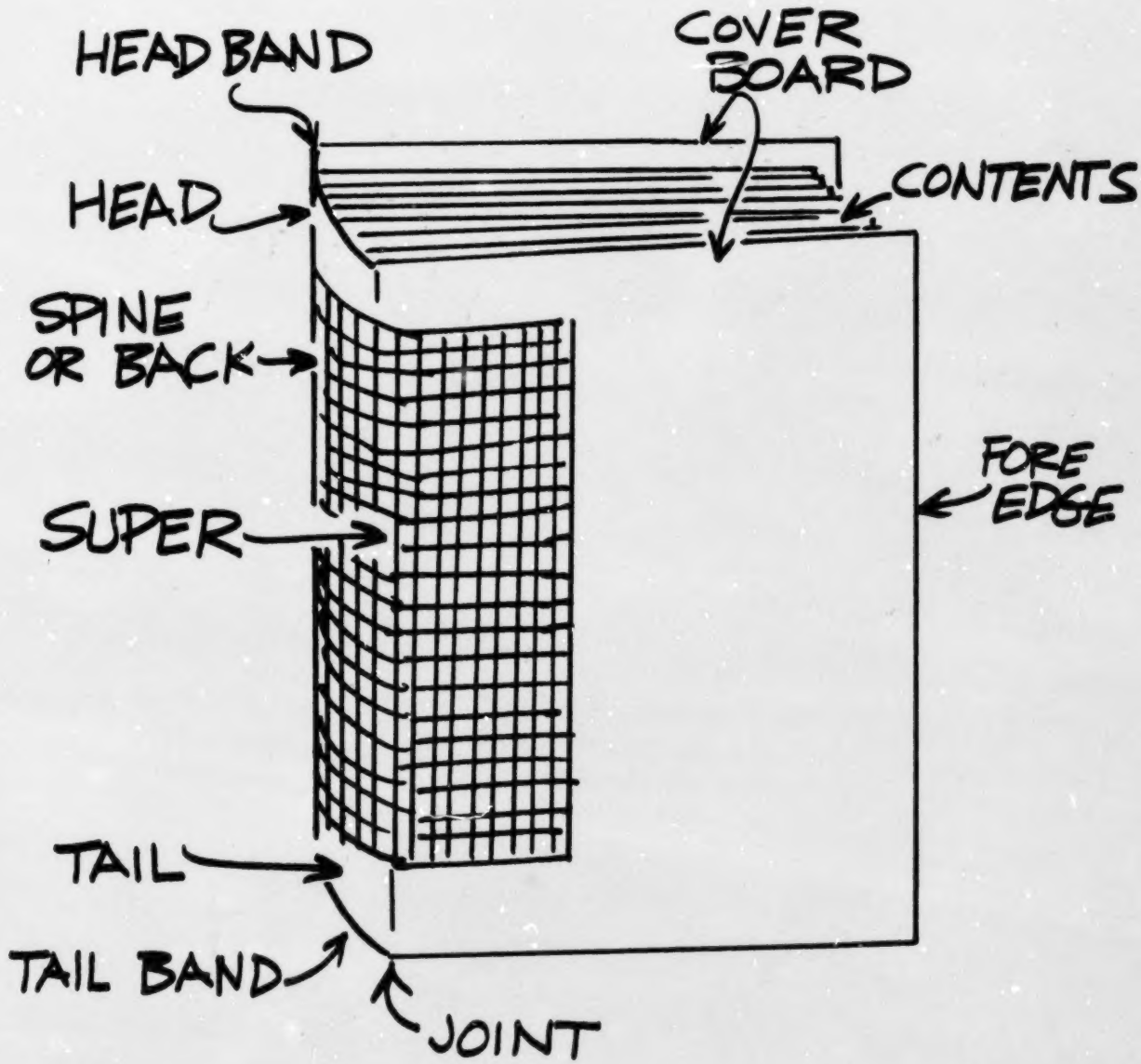
___ 5. Sewn case-bound binding is—

A. the best method
B. the most expensive method
C. used on most textbooks
D. all of the above

___ 6. Marbling is—

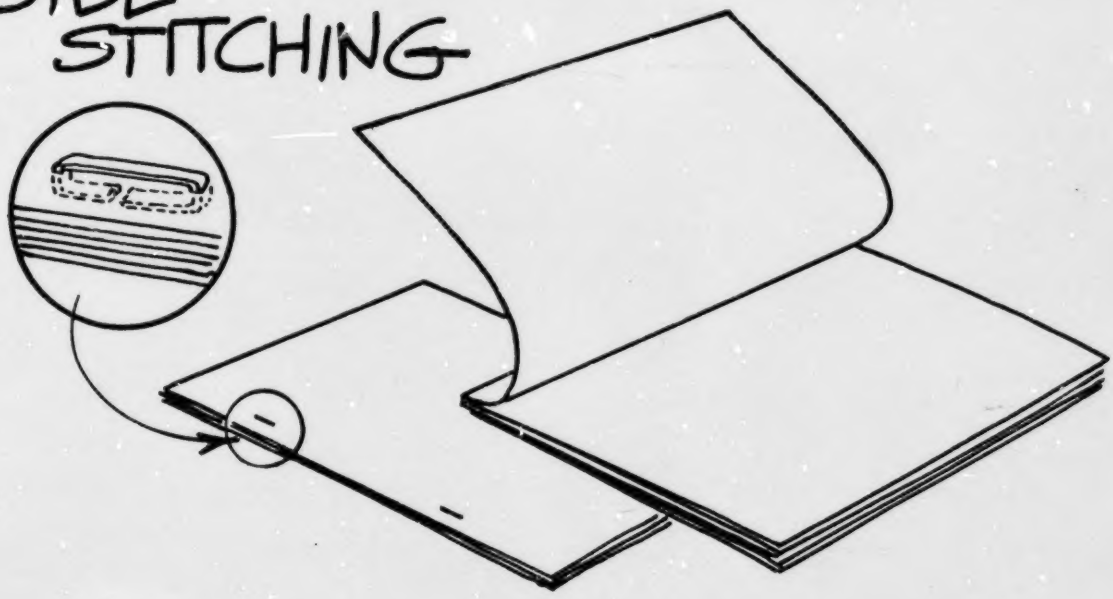
A. an effect used on end sheets
B. a type of binding
C. an effect in side stitching
D. an effect in saddle stitching

BOOKBINDING:
PARTS OF A BOOK



CONVENTIONAL BINDING METHODS:

SIDE STITCHING

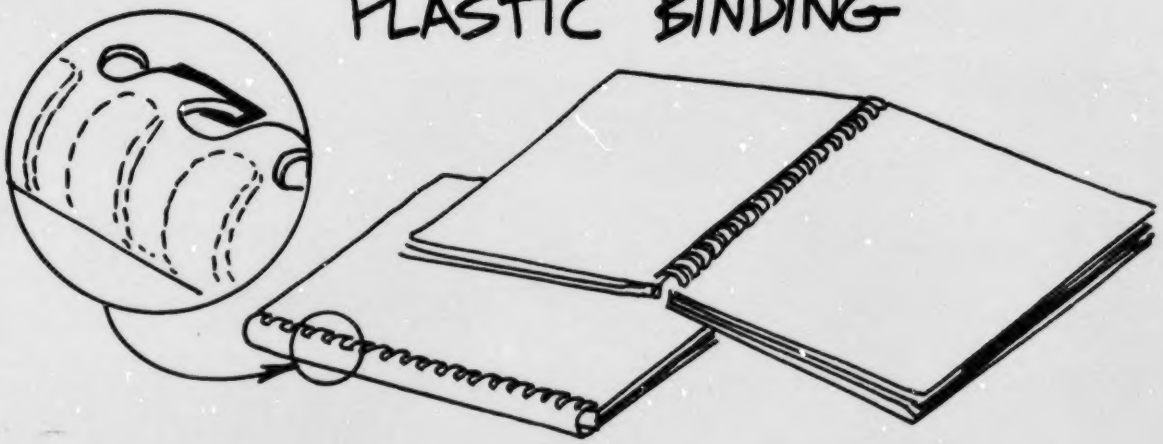


SADDLE STITCHING

BINDING METHODS:

SPIRAL BINDING

PLASTIC BINDING



Appendix A
Computer Applications in Graphic Arts

1. The use of computers in the production of books, magazines, and newspapers has burst upon an old, established industry with stunning effect.
2. The printing industry is being revolutionized by the use of computers in the various processes.
3. The activity most affected is that of typesetting, but related activities like copy editing and page composition are also involved.
4. In the late 1950s, the idea arose of bringing together typesetting equipment and computers to produce a more effective publication system.
5. The idea was initially received with much skepticism.
6. Early efforts proved outrageously costly, subject to many errors, and extremely complex to master.
7. But the pioneers persevered. Soon equipment firms, seeing the potential, continued to improve and develop typesetting systems.
8. Today, automatic typesetting is widely used.
9. Eventually, all major newspapers and other publications will be partly or completely converted to the use of the computer.
10. With the revolution in typesetting now well under way, the following changes are taking place:
    - gradual decline in the number of handkeyed typesetting machines with a proportional rise in computer-directed typesetting equipment
    - drastic decrease in the number of typesetters employed
    - continued increase in the number of characters set per day

Printing a few business cards is unlikely to be profitable with computer-aided typesetting. But printing newspapers, dictionaries, and telephone books will almost certainly be worthwhile.

The following factors make typesetting with computers workable:

1. The volume to be typeset is large.
2. Much copy is repetitive or computer-produced.
3. There is by-product value in saving the computer tapes produced.
4. Frequent changes in font, size, and style are made in the text.
5. A wide range of characters is required. For example, technical symbols are included.
6. The computer may be profitably shared with other activities.
7. Capital for equipment is available, but labor force for conventional typesetting is in short supply.

Other uses of computer technology in the graphic arts are as follow:

1. Teletext is an electronic system that delivers news text to television screens.
2. In effect, Teletext is a video newspaper.
3. The use of computers in the transmission and control of the Teletext message will be greatly expanded.
4. Another trend for delivery of news and information on home TV sets is the introduction of facsimile printers.
5. These devices will, in effect, print the images from your TV screen onto paper, right in your home.
6. Newspapers and other printed documents may be delivered through this method in the future.

7. An advantage is the speed in which newspapers will arrive in the home.
8. We have already mentioned about the use of computers in typesetting and processing systems. Other areas are involved in the preparation of printed material.
9. Imagine a television picture hooked up directly to a printing press or an offset platemaker.
10. Scientists and engineers have already begun to build video systems into graphic arts processes.
11. A large area that is impacting the graphic arts industry is OCR technology.
12. OCR refers tc optical character recognition. Using this process, printed or handwritten documents are read by machines.
13. With OCR methods, almost any typewriter can become a typesetting machine.
14. Many newspapers around the country have converted to phototypesetting through OCR techniques.
15. Another OCR technique is the use of an optical wand.
16. Large machines capable of reading whole pages of copy are being replaced by a pencil-like wand.
17. Light is transmitted through optical fibers. Images sensed at one end of the optical fibers are delivered at the other end.
18. With today's world becoming smaller and smaller by communications technology advancement, it is important for people in different countries to be able to communicate.
19. Translations are necessary, and computers are already translating languages.
20. OCR techniques enable a person to read in English and have the computer display and print it out in German or Chinese.

Regarding future careers in graphic arts:

1. Change brings opportunities for people who are prepared for new developments.
2. The graphic arts industry is rapidly changing.
3. Artists who paste up type today will be working at computer terminals in the future, and many are today.
4. The operator of a process camera will be retrained to work on an electronic scanner or use OCR techniques.
5. No matter how graphic arts products are produced, people will need more and more information.
6. Computer-based automation is bringing rapid advances in all areas of printing processes. Increased speed and quality of printing is resulting from these changes.

Appendix B
Books, Trade Journals, and Audiovisuals

BOOKS

Arnold, Edmund C. Ink on Paper Two. New York: Harper and Row Publishers, 1972.

Denman, Frank. The Shaping of Our Alphabet. New York: Alfred A. Knopf, 1955.

Dennis, Ervin A., and Jenkins, John D. Comprehensive Graphic Arts. Indianapolis, Ind.: Howard W. Sams, 1983.

Eastman Kodak Company, Dept. 412-L, Rochester, N.Y. 14650
Visual Literacy Programs That Work!
Visual Learning Materials, VR-11
Montage, VR-15
Exploring the World of Graphic Communications, GA-11-1 through GA-11-7
Graphic Communications Education, GA-13

Eastman Kodak Company. Kodak Graphic Arts Industry Manpower Study. Rochester, N.Y.: Eastman Kodak, 1982.

Hawken, William R. You and Your Camera. Garden City, N.Y.: Amphoto, 1973.

International Paper Company. Pocket Pal. 11th ed. New York: International Paper Company, 1974.

Kagy, Frederick D., and Adams, J. Michael. Graphic Arts Photography. Albany, N.Y.: Delmar Publishers, 1983.

Karch, R. Randolph. Graphic Arts Procedures- Basic. 4th ed. Chicago, American Technical Publishers.

"Repairing Books." The Dryad Press, Woodridge, N.S.

Shapiro, Charles, ed. The Lithographers Manual. Pittsburgh, Graphic Arts Technical Foundation.

U.S. Government Printing Office. Occupational Outlook Handbook. Washington, D.C.: CPO-United States Government Printing Office, Division of Public Documents, latest edition.

SELECTED TRADE JOURNALS

Book Production Industry, Market Publications, Inc., P.O. Box 696, 125 Elm Street, New Canaan, Connecticut 06840

Graphic Arts Monthly, The Graphic Arts Publishing Company, 7373 N. Lincoln Avenue, Chicago, Illinois 60646

Inland Printer/American Lithographer, Maclean-Hunter Publishing Corporation, 300 West Adams Street, Chicago, Illinois 60606

Modern Lithography, 8150 N. Central Park Avenue, Skokie, Illinois 60076

Package Printing and Die Cutting, Graphic Magazines, Inc., 61 Hilton Avenue, Garden City, New York 11534

Printing Impressions, North American Publishing Company, 134 North 13th Street, Philadelphia, Pennsylvania 19107

Reproductions Review and Methods, North American Publishing Company, 134 North 13th Street, Philadelphia, Pennsylvania 19107

AUDIOVISUALS

Transparencies

DCA Educational Products, 424 Valley Road, Warrington, Pennsylvania 18976

Graphic Arts Transparencies: GA-1 through GA-95

Photography Transparencies: PHO-1 through PHO-80

16mm Films

Basic Reproduction Processes for the Graphic Arts, Graphic Arts Films, Inc., Box 176, Glenville Stations, Greenwich, Connecticut 06830

Blue Sky Thinking, Ulano, Inc., 610 Dean Street, Brooklyn, New York 11238

Graphic Arts Technical Foundation, Inc., 4615 Forbes Avenue, Pittsburgh, Pennsylvania 15213

Graphic Communications--We Used to Call it Printing, E.I. DuPont De Nemours and Company, Inc., Advertising Department, Motion Picture Distribution, Wilmington, Delaware 19898

Gutenberg, Heidelberg Eastern, Inc., 73-45 Woodhaven Boulevard, Glendale, New York 11227

It's a Screen-Printed World, Advance Process Supply Company, 400 North Noble Street, Chicago, Illinois 60622

Lithography or Offset Printing, Graphic Arts Films, Inc., Box 176, Glenville Stations, Greenwich, Connecticut 06830

Messages, International Typographical Composition Association, Inc., 2233 Wisconsin Avenue N.W., Washington, D.C. 20007

Paper—The Messenger of Mankind, Hammermill Paper Company, Educational Services, Advertising Departments, Erie, Pennsylvania 16512

Printing: Platen Press Makeready, International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60600

The Colonial Printer, Contemporary Films, McGraw-Hill Films, Midwestern Office, 828 Custer Avenue, Evanston, Illinois 60202

The Alphabet--the Mark of Man, Contemporary Films, McGraw-Hill Films, Midwestern Office, 828 Custer Avenue, Evanston, Illinois 60202

Filmstrips

Photography filmstrips and cassettes from:

Arizona State University, Audiovisual Services, Tempe, Arizona 85281

DARMAR Productions, Gorham, Maine 04038

Photo-Offset Fundamentals, seven sets of filmstrips/cassettes, McKnight Publishing Company, Bloomington, Illinois

Slide-Tapes

Slide-Cassette Series, 40 Individual Programs, Including Learning Activity Packages

Photography slides and tapes/cassettes from: Eastman Kodak Company, Dept. 454, 343 State Street, Rochester, N.Y. 14650

PICA Foundation, The Printing Industry of the Carolinas, P.O. Box 4487, Charlotte, N.C. 28204

Order Department, Graphic Arts Technical Foundation, 4615 Forbes Avenue, Pittsburgh, Pennsylvania 15213

Introduction to the Halftone Process

Introduction to Lithographic Platemaking

Introduction to the Process Camera

Line Copy for the Process Camera

Photographic Film Process-Tray Method

Eastman-Kodak Company, Department 454, 343 State Street, Rochester, N.Y. 14650

Ideas Won't Keep

Photography Is

World Within Worlds

The Wonderful World of Typography

Typography Today, International Typographic Composition Association, Inc., 2233 Wisconsin Avenue N.W., Washington, D.C. 20007

Charts-Kits

Metric System (Chart), United States Printing Office, Division of Public Documents, Washington, D.C. 20402

Papermaking Kits

American Paper Institute, 260 Madison Avenue, New York, N.Y. 10016

Hammermill Paper Company, Educational Services, Advertising Department, Erie, Pennsylvania 16512

Career and Information Sources

American Paper Institute, 260 Madison Avenue, New York, N.Y. 10016

Graphic Arts Technical Foundation, Inc., 4615 Forbes Avenue, Pittsburgh, Pennsylvania 15213

International Graphic Arts Education Association, Inc., Graphic Arts Technical Center, 4615 Forbes Avenue, Pittsburgh, Pennsylvania 15213

International Typographic Composition Association, Inc., 2233 Wisconsin Avenue, N.W., Washington, D.C. 20007

United States Forest Service, United States Department of Agriculture, Washington, D.C. 20250